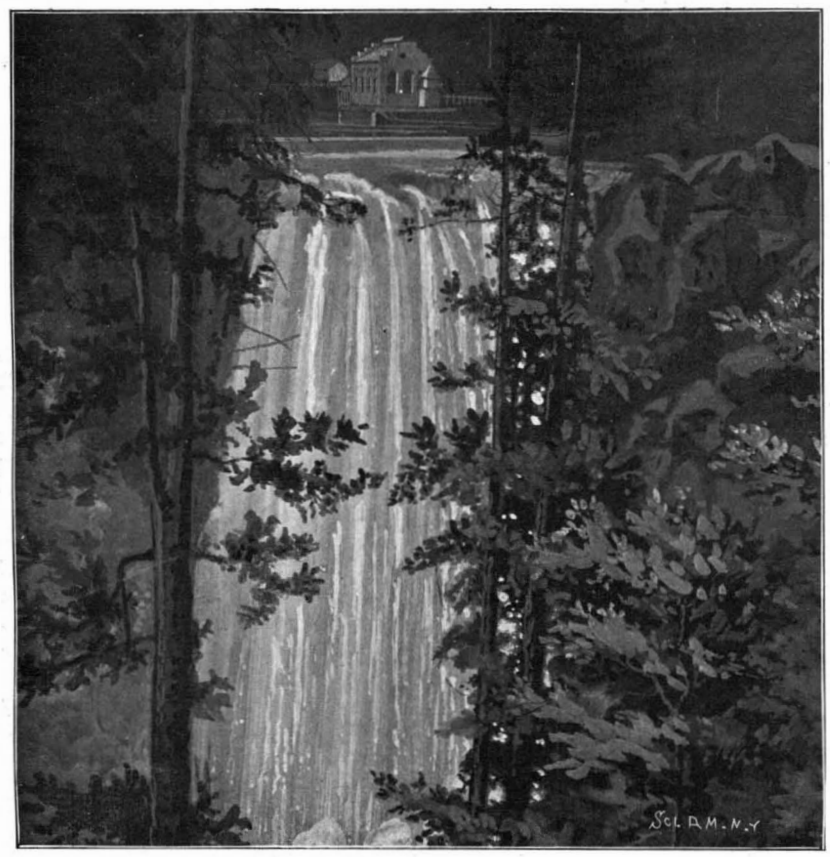
SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1902, by Munn & Co.]

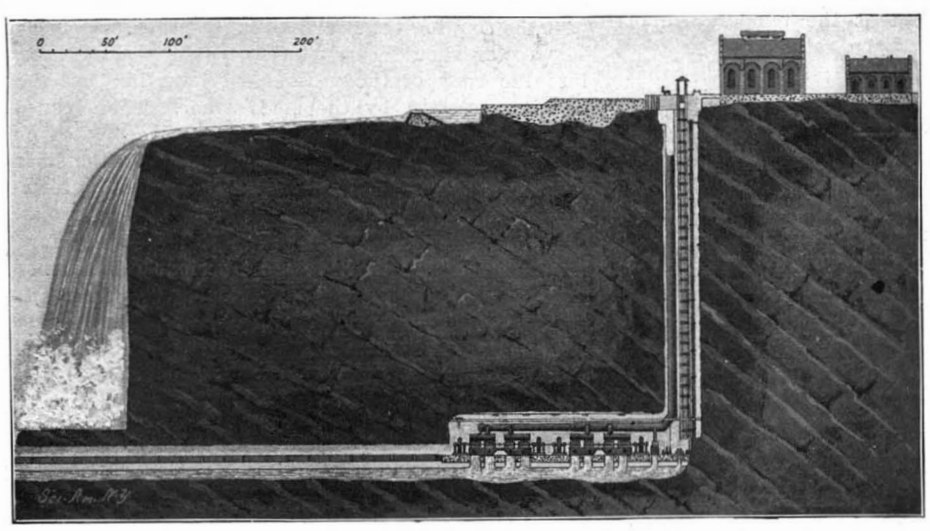
Vol. LXXXVII.—No. 9.
ESTABLISHED 1845.

NEW YORK, AUGUST 30, 1902.

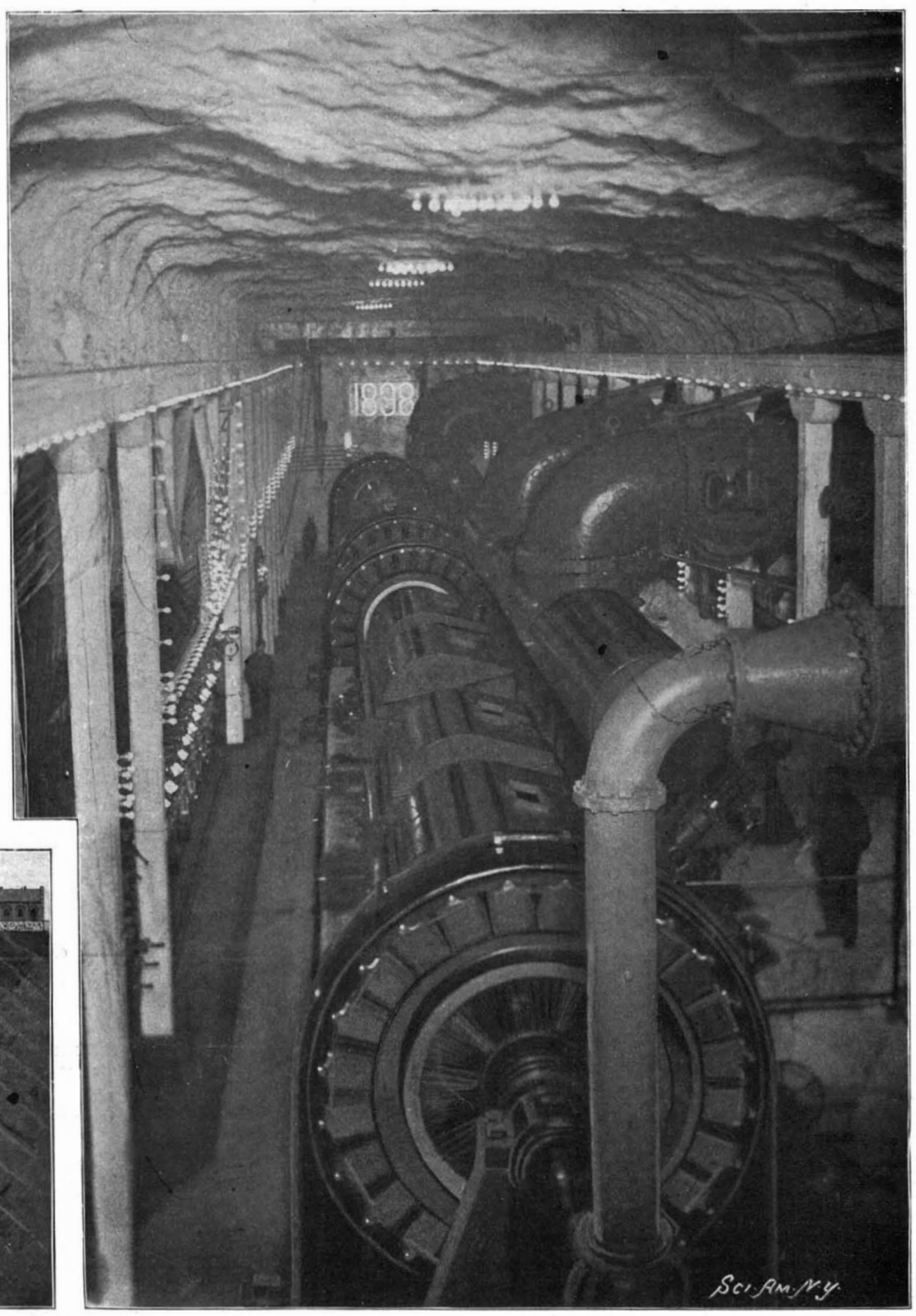
$3.00 A YEAR.
8 CENTS A COPY



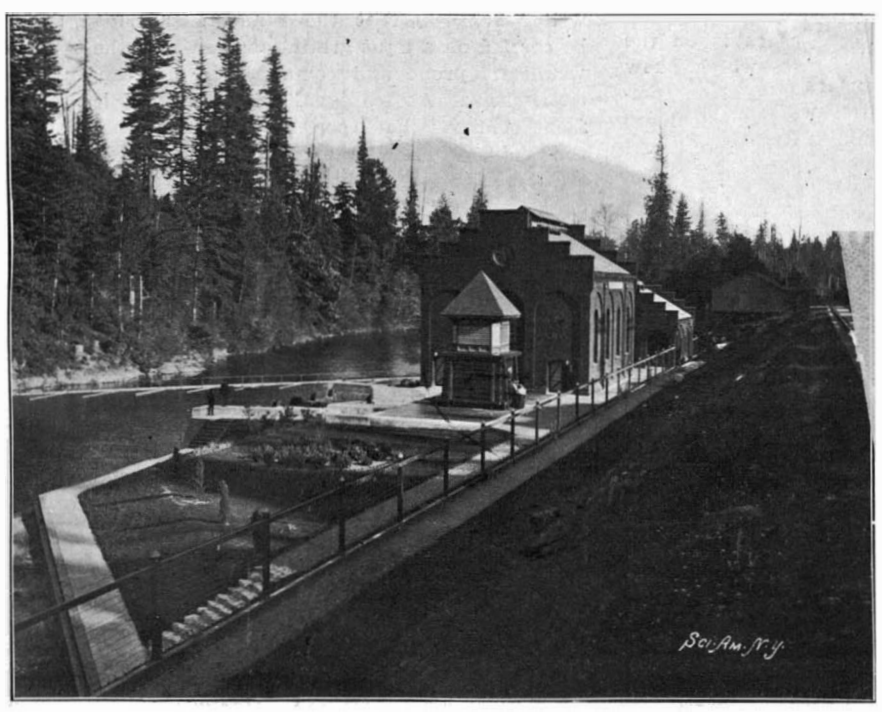
The Snoqualmie Falls.



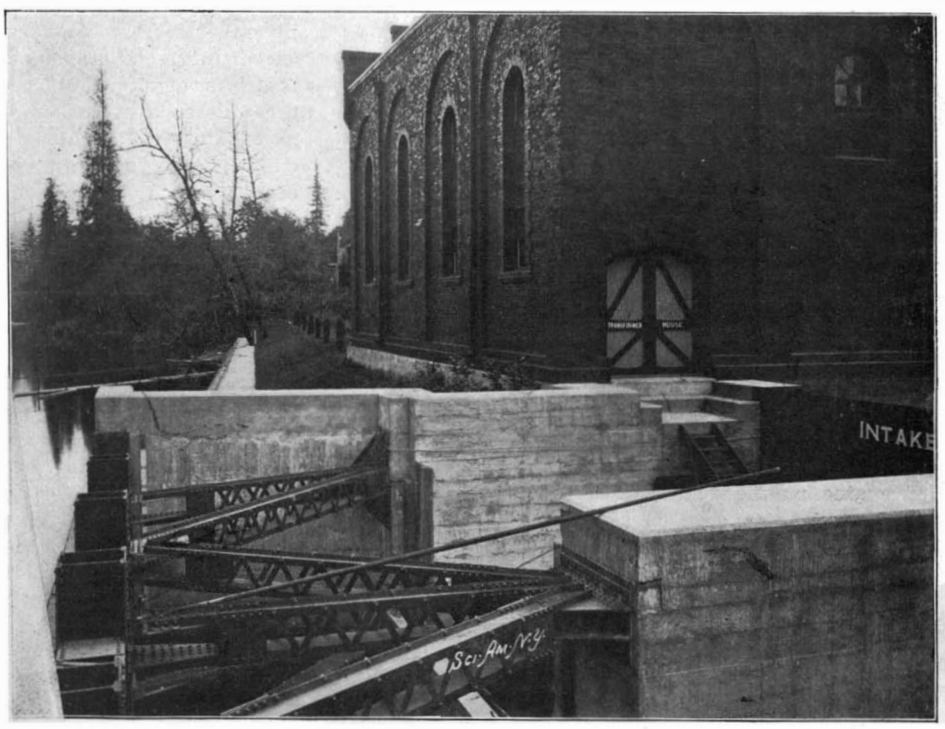
Longitudinal Section Showing Shaft with Penstock, the Underground Power House and the Tailrace to the River Below the Falls, Depth of Fall, 270 Feet.



Interior View of the Subterranean Power House. Excavated Out of the Solid Rock.



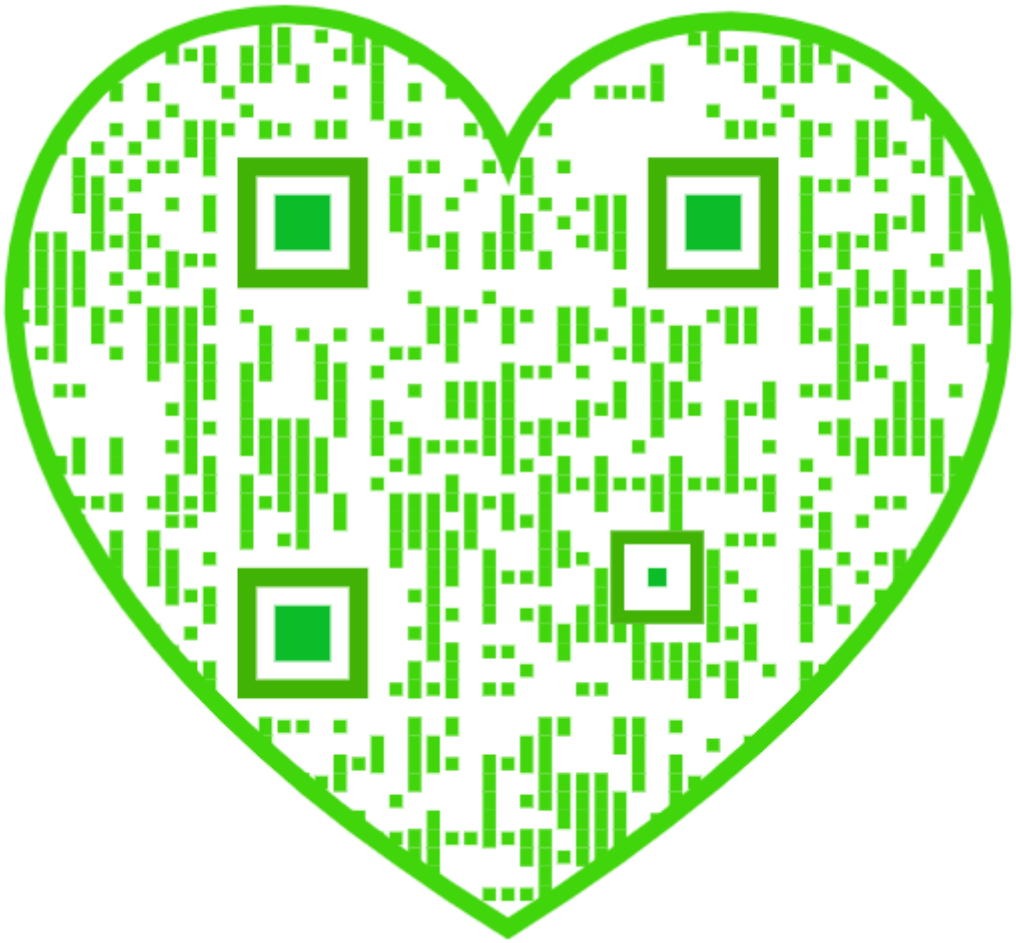
The Headworks Above the Falls, Showing Intake, Transformer House, etc.



The Intake From the River.

THE SNOQUALMIE FALLS POWER PLANT.—[See page 137.]

© 1902 SCIENTIFIC AMERICAN, INC.



SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) ..... $3.00 a year
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Monthly (Established 1885) ..... 2.50 "
Scientific American Export Edition (Established 1878) ..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, AUGUST 30, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

EXPRESS TRAINS OF THE FUTURE.

That the express train of the near future will not necessarily be hauled by electric locomotives is evidently the belief of the German Society of Mechanical Engineers, who have offered a series of prizes for the best-designed high-speed express train capable of carrying 100 passengers and their baggage, with every modern convenience of travel, at an average speed of 75 miles an hour for a continuous run of three hours' duration. There is no question that this competition was prompted by the disappointing results of the experiments in high-speed electrical traction, carried out last year on the stretch of military railway between Berlin and Zossen. It will be remembered that the failure of these trials, or rather their somewhat sudden termination, was due, not to the inability of the electrical equipment to drive the train at the high speeds contemplated, but to the unexpected weakness displayed by the track and roadbed, which, under the heavy concentrated and rigid loads of the motor trucks, yielded so seriously as to produce dangerous oscillation of the car. The object of the express train competition is to provide a train suitable for greatly accelerated railway travel, whose steam locomotive shall be able to exert the necessary power without imposing greater strains than the comparatively light track of the present state railways of Russia can endure. The Berlin-Zossen trials proved that the track of the state railways, as at present laid, is altogether too light for high-speed electric travel, and the German Society of Mechanical Engineers believe that it is possible to design a high-speed, steam locomotive train that would accomplish the desired result without damage to the track and roadbed. The trials demonstrated practically the fact, which might very well have been foreseen, that the steam locomotive with its high center of gravity and its spring-supported load, is far less severe upon a track than the electric locomotive with its low center of gravity, and its large proportion of non-spring-supported load. The effect of a low center of gravity is felt in rounding curves, and when the engine or cars begin to oscillate laterally from one rail to the other. With a high center of gravity the lateral blow against the rail is considerably cushioned and the lower the center of gravity, the more direct and hammer-like is the impact. This is a point that has been well understood by steam locomotive builders and engineers, and when the first of our American express engines with boilers placed above the drivers were introduced, it was found that, despite their great weight, they were actually easier on track, at least as regards lateral displacement, than the old type of locomotive with low boiler and low center of gravity. Of course, in the very nature of things, an electric locomotive carries its weights low, and hence at very high speed loads particular attention will have to be given to the lateral strength of the track and roadbed.

During the electrical experiments of last year an endeavor was made to gather data regarding the air resistance at varying rates of speed, and it was shown that the head-on pressure increased at a much more rapid ratio than the speed, though apparently not as fast as the square of the speed. As a result of the data so gathered, an endeavor is to be made to reduce air resistance by clothing the whole train from pilot of engine to the rear platform of the last car in sheet steel, with suitable sliding joints between the cars to give the necessary flexibility in rounding curves. This sheeting is to finish at the engine in a wedge-shaped front. Our readers will here be reminded of the experimental train designed by Adams and tested in some high-speed runs. The train in question made a good speed record, considering the moderate power of the engine that hauled it; and we think the probabilities are that if good results are secured with the proposed experimental train in Germany not a little of its success will be due to this special feature of its construction. According to the German technical publications, care will be taken in the construction of the locomotive to minimize the racking effect of the engine on the track, by carrying the weight upon a large number of wheels, twelve in all being used. There will be a four-wheeled truck at the front, followed by a pair of coupled drivers and a four-wheeled trailing truck beneath the firebox. The engine will be a three-cylinder compound, with the cranks arranged so as to secure a perfectly even turning movement.

LIGHT ON THE LIQUID FUEL QUESTION.

In a paper recently read by Mr. Edwin L. Orde before the Institution of Mechanical Engineers, at Newcastle-on-Tyne, on the subject of liquid fuel, the author stated that close examination of the literature which has appeared on the subject, seems to show that from some cause or another, many undoubted advantages which liquid fuel offers have either not been fully appreciated, or if appreciated, not pursued with sufficient determination to insure their realization in actual practice. In explanation it has been suggested that the reason why liquid fuel has a higher calorific value than solid fuel of the same chemical composition is, that some of the heat has been rendered latent in passing it from the solid to the liquid form; but the author points out on the other hand that experiments fail to show the existence of this latent heat, quoting as an authority Dr. Paul, who holds that the best results that can be obtained from liquid fuel are an evaporation of 16 pounds of water at 212 deg. F., which is about 50 per cent more than any good coal will give in an efficient boiler. The most important point made in the paper was the explanation as to why liquid fuel does not give evaporative results in actual practice corresponding to those obtained in laboratory tests. Mr. Orde attributes the difference to the fact that crude oil exclusively is used in boiler furnaces, and that this oil contains a great amount of water. Ten per cent is the proportion quoted in the paper, although, as a matter of fact, many oils contain a higher percentage than this. The presence of this water destroys the conditions necessary for perfect combustion. Its first effect is to reduce the temperature of the flames and increase their length, thus moving the point of highest combustion further into the furnace, with the result, first, that a large portion of the heating surface of the furnace is rendered useless; secondly, that the temperature of the combustion chamber may be raised to a higher point than is good for its material; and thirdly, that the last stage of combustion takes place in the smoke-box and uptake. The existence of a low furnace temperature is suggested, furthermore, by the fact that in cases where no smoke was being formed and the air supply was not more than 20 per cent above the amount that was chemically necessary for the combustion of the fuel, the evaporative work of the boiler was poor.

In commenting editorially upon Mr. Orde's paper The Engineer states that it has authentic evidence of oil being shipped from oil wells which contained as high as 40 per cent of water, this large amount having been added, not fraudulently, but having flowed naturally into the wells, which are usually driven through water-bearing strata. As crude oil is nearly as heavy as water, and only separates from the latter after a long rest in the tanks, it follows that on shipboard, where the bunkers are in constant motion, separation is impossible and the water is carried with the oil into the furnaces. In concluding his paper Mr. Orde quotes actual results obtained by successful installations of burning apparatus on the steamers of three different companies, which show the difference in consumption of liquid fuel as compared with coal. In the case of the four steamers quoted, there is an advantage in favor of liquid fuel of 27 per cent, 28.6 per cent, 35.5 per cent and 36 per cent. The conclusion arrived at is that except in the case of steamers which are engaged in carrying oil as cargo, or those which are employed in the oil-producing region, liquid fuel cannot show sufficient pecuniary advantage over coal to render its entire adoption advisable.

THE RECENT "BELLEISLE" EXPERIMENTS.

In a characteristic discussion of the recent "Belleisle" experiments, Mr. F. T. Jane, the well-known author of "All the World's Fighting Ships," sums up the experiments as having two main objects: First, to ascertain the effect of lyddite on a conning tower, and, second, to ascertain the effect of shells on torpedo nets. After a careful analysis of the results, he points out the main lessons that are to be learned and presents his own suggestions as to how far they should modify future battleship design. The whole article as given in The Engineer will be found in full in the current issue of the SUPPLEMENT, and it will be sufficient to give here a brief review of Mr. Jane's analysis of this interesting trial. It is pointed out that in the first case the experiment was invalid because the conning tower of the "Belleisle" was not of a modern pattern, being entered from below instead of, as is now the practice, from the rear. Attention is drawn to the fact that the gas from the exploding lyddite shells was only able to act upon the top of the tower, whereas in the modern type of conning tower, which has a doorway through the rear wall with a curved screen to partially cover it, the blast of an exploding shell would be able, if the latter came from a wide arc on either beam, to enter between the screen and tower and find its way, with deadly impact, throughout the whole of the interior of the tower. In the "Belleisle" tower the gas could only enter through the peep-hole slot at the top, and hence there would be something of an air-cushion effect before the pressure reached the floor of the conning tower, on which, before the firing, a live rat had been placed to test the effect upon a living being. As we take it, Mr. Jane's argument is that though the modern conning tower with open rear entrance and so-called protecting screens may keep out shells, it will not prevent destruction of the inmates by the shock of the shell gases. He suggests the construction of a double-deck conning tower, to accommodate a steersman in the upper compartment, and a reserve steersman below. He would place the commander of the ship on the roof of the turret, this roof to be extended to form a wide, circular platform, around which platform would be hung a wall of splinter nets, the idea of this arrangement being that the splinter nets would catch the lighter flying fragments, but would not present sufficient resistance to burst the storm of explosive shells, to which the captain himself would offer but a small target. He suggests that the best position for the captain in the heat of action would be prone upon this upper roof with his mouth above the speaking tubes, etc., which would lead down into the conning tower below. The suggestion that the captain should fight his ship practically in the open is warranted by the fact that in the Spanish-American war the commanders of our vessels preferred, like Admiral Dewey, to carry on the action from the bridge, where they could obtain a clear view, rather than be cooped up within the restricted outlook of the conning tower.

Early in the action the bridge of the "Belleisle" was struck and completely wrecked, the mass of wreckage being swept away and carried overboard. From this it is argued that it would be folly to support the conning tower or fighting position on a bridge. The tower should carry its full diameter well down into the body of the vessel, and have its base thoroughly protected by the side armor. There can be no question as to the necessity, as above pointed out, for giving most thorough protection both to the steersman and the reserve steersman; for should the former be killed or disabled at a critical moment in battle it is easily conceivable that the delay in sending for a "replace-man" might have most serious consequences, and, possibly, be fatal to the ship. By building the conning tower in two stories, and having the "replace-man" in the story below, the risk of the ship running wild is reduced to a minimum.

The awful destruction wrought by the lyddite shells and the dense clouds of dust and fragments produced by the explosion indicate that there are two other most important accessories that demand attention; the first, the important matter of placing the range-finder, and the second, signaling. Ordinarily the range-finder is carried on the bridge, but the short work made of this structure on the "Belleisle" shows that some other position must be found, and the writer suggests that the range-finder tripod should be carried on a light grating, upon which the operator would lie prone and communicate the ranges by a transmitter. As to signaling, the "Belleisle" experiment confirms the experience gained at the battle of the Yalu, where the signal halyards were entirely swept away; for the bombardment gave little promise of the survival of even the light masts. There are two methods of signaling suggested, one a small captive balloon carrying flags which may be hoisted and cut away and sacrificed when done with, and the other suggestion is the use of colored shell for simple signals.

When the writer comes to the question of the effect of high-explosive shell fire on the personnel of the ship, we think that he is dealing with what, after all, is the most vulnerable point of attack in the modern warship. We are satisfied that in a battle carried out at moderate ranges between ships whose crews are fairly proficient marksmen the fight will be determined by the decimation of the crews, rather than by the destruction of the ships. Unquestionably many will be placed hors de combat by mere concussion, whether by the impact of shells on the outside of the turrets and casemates, or by the atmospheric shock and asphyxiation due to the bursting of high-explosive shells within the inclosed spaces of the ships. It is true, as Mr. Jane points out, that the actual effects of gun fire on the personnel is a matter of conjecture, and unless volunteers can be found who will place themselves within such a vessel as the

© 1902 SCIENTIFIC AMERICAN, INC.

"Belleisle" when she is under fire, and secure the enormously valuable data which can only be obtained in this way, we shall remain in comparative ignorance of the actual destructibility of modern gun fire. At the same time it is probable that public sentiment would array itself strongly against the proposal to risk the sacrifice of human life in such an experiment.

GEORGE M. HOPKINS.

It is with most profound sorrow that we record the decease on the 17th inst. at Cheshire, Mass., of Mr. George M. Hopkins, so long identified with the SCIENTIFIC AMERICAN as Associate Editor.

It was while enjoying a vacation trolley outing with his wife in this beautiful locality among the Berkshire Mountains that Mr. Hopkins became suddenly ill on the 15th, and despite the best medical treatment, never recovered. His sudden demise will be a great shock to his intimate associates in the SCIENTIFIC AMERICAN.

Mr. George M. Hopkins was born in Oakfield, Genesee county, New York, November 21, 1842, and while a lad went with his father and family to Albion, Orleans county, New York, where he received the usual public school education. He early displayed a liking for mechanics, having a natural ability to discover the reason of things in a mechanical way as they were studied. His father encouraged him to pursue matters to his liking by having him obtain practical information in the workshops at Albion.

On May 10, 1864, he was married to Helen M. Mills, daughter of Dr. A. B. Mills, of Albion, N. Y. Later, in 1866, we find he was granted his first patent for an apparatus for turning leaves of music, after which followed some forty-three other patents; among them, in 1871, was an electro-magnetic sewing machine, and from 1880 to 1885 he was granted two patents for telegraph relays, five patents on telephone transmitters and two patents on telephone receivers. His telephone transmitter patents were acquired by the People's Telephone Company at that time and their utility was well demonstrated. He was also interested in gas engine construction and secured several patents in that line, showing that his activity as an inventor never failed him in whatever branch he applied his mind.

He early made the acquaintance of Thomas A. Edison, in whose laboratory he worked, and the friendship continued throughout the epoch of the telephone and electric light development, and to the present time.

On May 10, 1876, he became connected with the SCIENTIFIC AMERICAN, beginning his work as an attorney in the Patent Department; it was soon noticed that he evinced a fondness for experimenting in matters connected with physics, especially in a more simple and direct way than was customary. He was encouraged in this work and from time to time the results were published in the SCIENTIFIC AMERICAN. The experiments were so simple and clear that any boy could understand them. The value of the published experiments was that they were based on actual manufacture of the apparatus and trial before publication. It is needless to add that these many different publications formed the nucleus of Mr. Hopkins' popular book, "Experimental Science," which has been of such assistance to many thousands of students of physics.

Some months ago Mr. Hopkins undertook a thorough revision of the book, with a view to bringing it up to date, that many of the remarkable discoveries of the last few years might be included.

It is a great gratification to feel that this work was entirely completed, and that the proofs had been thoroughly revised and read by Mr. Hopkins before he started on his vacation several weeks ago. The popularity of the work is shown by the fact that the twenty-third edition has just been published. Our illustration is from a recent photograph and is regarded as an excellent likeness of Mr. Hopkins.

Of late years he gave particular attention to literary work, editing the special department of "Notes and Queries," and contributing to our columns a series of scientific articles which were marked by the clearness and brevity by which his work is easily recognized. Mr. Hopkins possessed in a marked degree the literary qualifications of a scientific writer. To his simplicity and clearness of style, no doubt, was largely due the great popularity of his writings, which attracted and held the interest of the widely diversified classes of readers who were interested in the subjects he discussed and subscribed for his published works. It is certain, moreover, that his directness and purity of style were one expression of the character of the man himself; for our late associate was possessed of sterling traits that won for him the invariable respect and admiration of all those with whom he had business relations.

His disposition was most kindly, amiable and attractive. He was ever ready to render assistance and freely impart such knowledge as he possessed.

Mr. Hopkins occupied his leisure hours with the practice of photography as a stepping stone for the study of art. He enjoyed painting small pictures as a pastime, using his photographs as a guide. He was fond of broad effects. On another page we give his method of producing them.

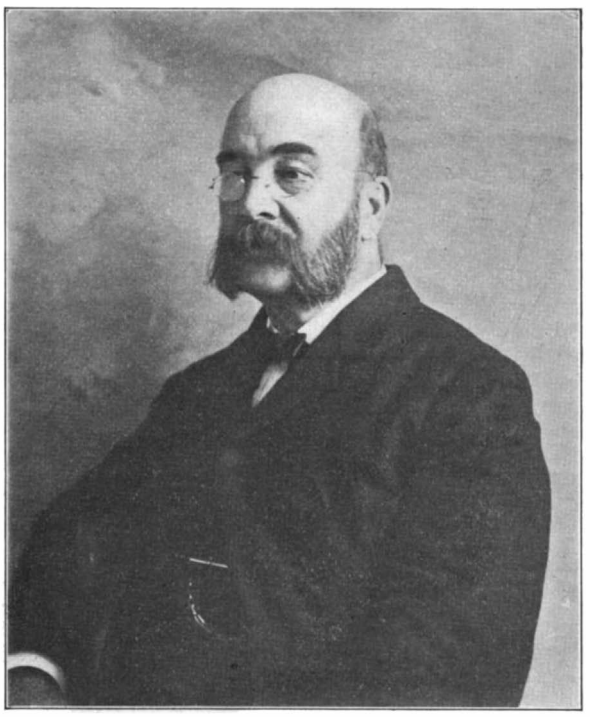
He was a member of a number of societies. His residence was in Brooklyn, New York, where, we are informed, he left a most remarkable collection of scientific apparatus, which exceeds in interest the equipment of many institutions of learning.

He leaves a wife and one son, Mr. Albert A. Hopkins, who was formerly with the SCIENTIFIC AMERICAN for several years and is author of "Magic" and "The Scientific American Cyclopedia of Receipts, Notes and Queries." One brother, Mr. I. N. Hopkins, also survives him.

Mr. George M. Hopkins was greatly beloved in the church he attended in Brooklyn and was held in high esteem by all who knew him. We shall miss him and we know our numerous readers will, but we believe the work of his life, "Experimental Science," will live and the memory of his name will endure with it as one who knew how to teach science with rare simplicity.

THE LAYING OF A PACIFIC CABLE.

The President has consented to authorize the Pacific Commercial Cable Company to lay a cable across the Pacific to the Philippines, thus ending the fight which has been waged for fifteen years by rival firms. The Mackay-Bennett Company will probably soon begin work. The route to be followed extends from San Francisco to Guam and thence to Manila. The estimated time of laying the cable is fourteen months from the beginning of the work. Heretofore all messages have been sent to the Philippines over an English line from Hong Kong. The owners of this line have a franchise monopoly granted by the Chinese government. Under the favored nation clause of the



GEORGE M. HOPKINS.

treaty between the United States and China the American government has the right to claim a similar franchise for an American cable company. It is expected that advantage will be taken of this treaty relation, for by getting a terminal in China the cable company will obtain 700 miles of new cable lines. The Pacific cable will then connect with the Atlantic cable lines in China so that messages can be sent to all parts of the world by American cables.

ELECTRIFIED HOUSES.

An instance of non-familiarity with simple scientific facts is illustrated by an article that goes the rounds of the press once or twice annually, namely, the story of the electrified house. The article usually states that some one has discovered that everything he touches in his house, the radiators, picture frames, banquet lamps, etc., give him an electric shock. Hence, he fears there is some connection between the arc-light wires and the water pipes near his residence. The electric light inspector is, therefore, summoned, and reports that the wires of his company are intact and that e electricity must come from some other sourc does not dawn on any of the people consulted the discoverer of the phenomenon is unconsci erforming one of the simplest and oldest of e. atic experiments, the shuffling of his shoes ov dry carpet raising the potential of his body eral thousand volts, which discharge at every op y. One may even get electric discharges from ckles to the brass lock of a hand-bag which he be carrying while walking on a stone pavement cold, dry weather. But, dismissing newspaper it is somewhat astonishing, in view of the ways in which in cold, dry countries electricit unintentionally developed and manifested by sparking, that the first knowledge concerning this phenomenon did not come to the ancients in this way rather than by the attraction of light substances by amber. The explanation of this, however, may be that the scientists of bygone days did not reside in cold, dry countries.—Cassier's Magazine.

SCIENCE NOTES.

The radiations of radium have proved to be of rare value in medicine. It is found that a metallic screen interposed between the eye and a vial containing radium in no way prevents the healthy eye from seeing it. If the retina of a blind person be healthy, it will be effected by radium rays even though the cornea be opaque to light rays. Consequently the radiations from radium can be used to discover whether or not the retina of a blind person is healthy.

The expedition dispatched last summer to Gambia, on the West Coast of Africa, by the Liverpool School of Tropical Medicine has discovered another malaria-spreading animal, the parasite trypanosoma. This parasite resembles a minute worm, and is very similar to the blood parasite which is the cause of the devastating disease prevalent among cattle, horses, etc., and in Africa, India and other tropical countries known as the tsetse fly disease, nagana and surra. In the case of animals it has been proved that these diseases are communicated through the agency of certain biting insects, such as the tsetse fly. The expedition discovered the trypanosoma parasite in the blood of a native child. Since the return of the expedition a special study of the question has been made at the laboratories of the Liverpool school and it has now been resolved to dispatch a further new expedition to the West Coast to investigate the conditions in which the disease occurs in both Europeans and natives and its distribution, and also to ascertain how it is conveyed from man to man; whether by biting insects or by other means.

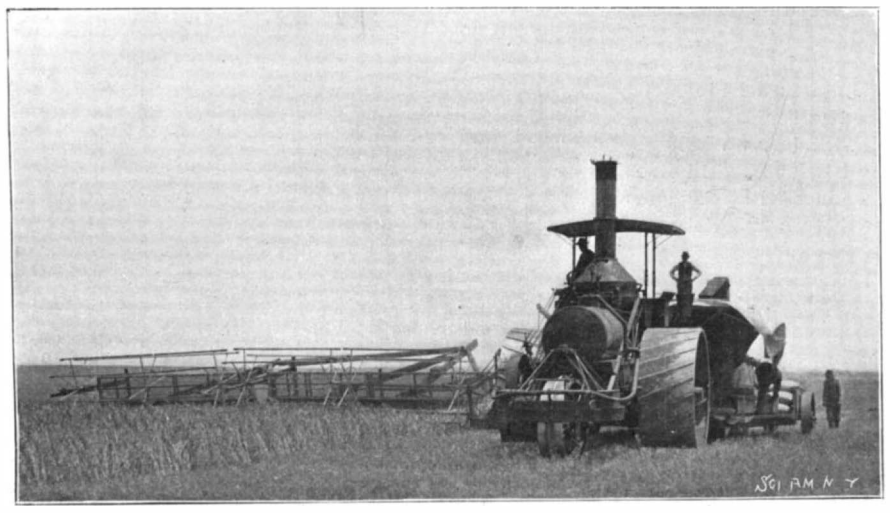
The fitting out of the Scottish South Pole Expedition, which is to be carried out under the auspices of the Scottish National Antarctic Expedition, is rapidly approaching completion. The expedition is to be under the command of Mr. W. S. Bruce. The Norwegian whaling vessel "Hecla," renamed the "Scotia," purchased to carry the party, is now being reconstructed on the Clyde, at Troon, under the superintendence of Mr. G. L. Watson, the well-known yacht designer. The "Scotia" is a bark-rigged auxiliary screw steamer of about 400 tons register. New deckhouses are being built, a larger one aft and a smaller one forward divided into a laboratory and cook's galley. A second laboratory and a dark-room are being fitted between decks. The ship is being specially fitted to carry on oceanographical research, both physical and biological. Two drums, each containing 6,000 fathoms of cable, for trawling in the deepest parts of the Southern and Antarctic oceans, are being taken. The expedition intends to follow the track of Weddell, and to explore the Ross deep, working eastward from the Falkland Islands.

The Zoological Garden of London has lately received a young animal known as the Panda. This animal, a small mammifer of the Procyonidæ family, constitutes a unique species in the genus Aelurus (*A. fulgus*), and comes from the Himalayas, where it is found at altitudes varying from 6,000 to 11,000 feet. It is also found in the mountains to the north of the Assam as far as the Yuman region. Its ordinary name is "red cat-bear," the name being due to its appearance and its plantigrade walk, also to the reddish color of the fur. The Aelurus genus exists in the fossil state, and one species, that of the *A. Anglicus*, is found in England in the pliocene layers. The Panda is not often seen in Europe. The first specimen which arrived at London was sent in 1869, but its two companions died *en route*. The survivor did not live longer than seven months. It was made the subject of careful observations by zoologists, especially by Sir William Flower and Mr. A. E. Bartlett. It is interesting to note that the Panda now in London often uses his forepaws like arms and hands. Mr. Hodgson, who observed the species in the East Indies, never saw the Panda act in this way and use his anterior members to seize objects. A second Panda was sent to London in 1876. The habits of the animal are nocturnal, and during the day he sleeps almost constantly. He seeks his nourishment in the evening or very early morning, living upon herbs, buds, roots, and will also eat eggs and insects. The character of the animal is rather mild; the large claws with which his fingers are provided are used not for attack or defense, but mainly to climb trees, in which he passes a good part of his time, except in the periods when he seeks his food, this being generally obtained on the ground. He is not timid, but does not like to be touched. When a person extends his hand toward him, he sits down, and agitates his arms as if to strike, but his anger is short lived and he allows himself to be observed without much inquietude.

© 1902 SCIENTIFIC AMERICAN, INC.

A MAMMOTH COMBINED HARVESTER.

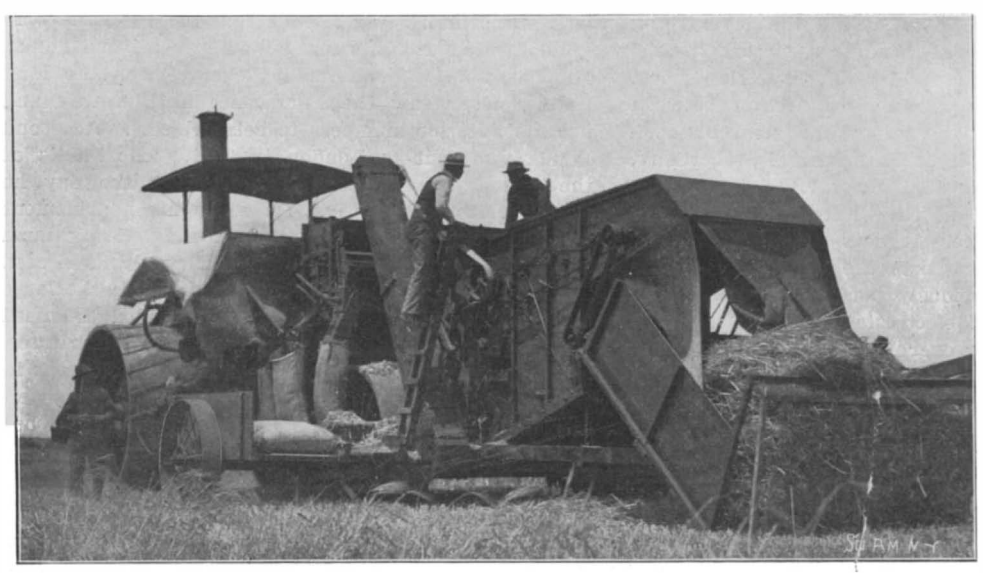
Our Western States with their thousands of acres of farms are continually astonishing the world with the enormous proportions of their agricultural machinery. Just now our attention is called to a combined harvester, which we illustrate herewith, and which is claimed to be the largest in the world. This harvester has a very wide reach, having a cutting-bar 35 feet long. The entire process of harvesting and threshing is accomplished in the machine. The stalks are cut and conveyed by a suitable means to the threshing mechanism. Here by the use of a system of cylinder, separator and recleaner, the grain is separated out, cleaned, and fed into sacks, as shown in one of our illustrations; the straw at the same time is conducted to the straw box at the rear of the machine. The threshing cylinder is 28 inches in diameter and the separator has a width of 54 inches. An automatic governor on the fans governs the blast so that at any speed at which the harvester may be traveling, the wind is automatically regulated and prevents clogging of the shoe and the carrying of grain over into the straw—a difficulty which often occurs in harvesters which are regulated by hand, because this part of the operation is very often forgotten or neglected.



FRONT VIEW OF THE COMBINED HARVESTER.

The harvester is entirely steam-driven and is connected by suitable coupling to a 50 horse power traction engine by which it is propelled. The usual method of operating such machines is by means of gearing and universal joint connection with the traction engine. This machine is, however, entirely independent of the traction engine for its motive power, being provided with an auxiliary engine of 8½-inch bore and 7-inch stroke, which is located on the frame of the harvester. This engine is driven by steam, conducted through a flexible tube from the boiler of the traction engine. It furnishes all the necessary power for operating the mechanism and fills a deficiency which will be readily appreciated by those who are acquainted with the requirements of such a machine. Heretofore these parts were dependent upon the travel of the traction engine for their operation. Now a steady, uniform motion is assured at all times, no matter what the condition of the grain may be, or at what speed the traction engine may be traveling.

The traction engine is designed to burn either coal, wood, oil or straw. When straw is used as fuel, an endless carrier is provided for conveying the material from the straw-box to the fuel-box of the engine. It is interesting to note that in California, where this machine is in use, oil has proved to be the most economical fuel, the consumption per day being coal, 1 ton at $8.50 per ton; wood, 2 cords at $4.50 per cord; oil, 330 gallons, at 70 cents per barrel. The capacity of this machine is from 1,000 to 1,500 sacks, or from 70 to 100 acres harvested in a day. This too, at a cost not exceeding 50 cents per acre for cutting, threshing, recleaning and sacking the grain.



A MAMMOTH COMBINED HARVESTER—THE THRESHING MECHANISM.

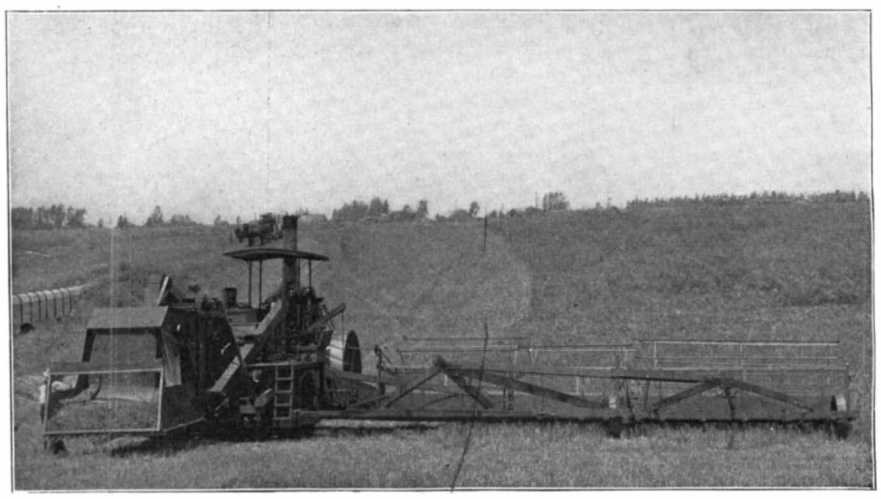
A Large Western Cotton Mill.

BY DAY ALLEN WILLEY.

The erection of a cotton mill in the vicinity of Kansas City, Mo., is of unusual interest not only on account of the remarkable size of the proposed plant but from the fact that it is to be located in a new site for the textile industry and marks the beginning of what may be an important industrial development in the Southwest. The mills will contain an equipment of 12,000 looms and 500,000 spindles—being by far the largest plant of the kind in the world. The Amoskeag Manufacturing Company of New England is at present the most extensive, being greater in dimensions than any of the factories in the Lancashire district of Great Britain, but the Western company will exceed the Amoskeag by 200,000 spindles and 2,000 looms. The equipment will be installed for manufacturing plain sheetings ranging in size from 2½-yard drills to print cloths as well as 4 and 5-yard sheetings. The yarns produced will run from Nos. 8 to 20 for the drills and 30 to 50 for the larger goods. A further idea of the capacity of the plant can be gained when it is stated that its estimated annual output when running to its full capacity will be 75,000,000 pounds of finished goods and its consumption of cotton 170,000 bales.

The mechanical features connected with the building of the Western factory are also of unusual interest. Its electrical equipment will be very elaborate in character and contain the latest devices for the economical driving of the weaving and spinning rooms by motors. No water power is to be secured at the site, as at many points in the Piedmont section of the South and in New England, so that the necessary current will be generated by steam power, the engines being direct connected to large dynamos or belted to them. From the generators the current will be distributed to the battery or series of motors each operating its individual set of looms or spindles. The plan followed in general will be similar to that utilized in equipping the Olympia Cotton Mill, of Columbia, S. C., where the machinery is driven entirely by electricity. The motors serving the spinning frames are to be of 150 horse power each operated at a current ranging from 575 to 580 volts, and are of the three-phase pattern. Each motor will serve 10,000 spindles, so that the total number alone in this department will be 50. Motors of the same size will be installed in the weave rooms on an average of one to 750 looms, representing five looms per horse power. The motors will be attached to the ceiling and connected with the apparatus by as short circuits of wiring as possible with the view of economizing power to the greatest possible extent. By this system it is calculated that a saving ranging from 15 to 20 per cent in power will be effected, compared with a plant operated by steam direct, for it will be noted that one section of the factory can be operated by its own motor entirely independent of others, allowing any part of the equipment to be run during a dull season or while repairs are being made to the other portions, yet without waste of power or needless wear and tear of equipment. It is hardly necessary to say that the textile industry as yet is comparatively unknown west of the Mississippi River. In fact it has scarcely obtained a foothold even in Texas, which in recent years has produced over one-third of the American cotton crop. A few statistics will emphasize this fact. Out of about 425 mills now in operation in all the Southern States, but 15 are running in Texas, Louisiana, Arkansas and Missouri, combined with two or three in Indian and Oklahoma Territories. All combined represent but 140,000 spindles out of the 4,375,000 in the South. As will be noted, the Kansas City plant when entirely completed will contain over one-tenth of the total number of spindles at present installed in the South. It is unnecessary to say that raw material is abundant, as the last few years have demonstrated that Indian and Oklahoma Territories, as well as Arkansas, are as favorably situated for raising middling cotton of a good grade as the territory in Georgia and the Carolinas. They have equal advantages, not only in climate, but in quality of soil. Already the two Territories mentioned plant 700,000 acres annually in the staple, while the average acreage of Texas is nearly 8,000,000.

As it is expected to provide the plant described with furnaces for burning oil or for solid fuel, advantage will be taken of the extensive deposits of petroleum in Texas, which can be shipped to it by rail in tank cars. Coal can be obtained from the McAlester mines in Indian Territory and in this way the question of fuel supply is disposed of. It is expected to secure a fair grade of labor from Kansas City, as well as the farming population in the vicinity, which will be trained by experts from New England and South Carolina. As to the market for the product, the company expects to sell mostly in the West and on the Pacific coast, but will make a grade of goods suitable for the Chinese and Japanese demand. As is well known, the market in the Orient has taken a very large quantity of the goods from the Carolinas, Georgia and Alabama mills within the last few years, and this trade will be catered to.



REAR VIEW—SHOWING THE GREAT REACH.

The Mystery of a Spider's Spinning.

How does a spider spin a thread from one bush to another at a height from the ground and then draw it so tight? asks a correspondent in the New Century. Everyone who has ever walked through a country lane early in the morning has felt the strained threads upon the face, and often these threads are many yards long, but the way in which it is done remains a mystery. He does not fly across, drawing the thread after him, for he has no wings. Neither does he descend to the ground and then climb the opposite bush, for this would lead to immediate and hopeless entanglement of the gossamer filament. How then does he do it?

M. Favier, a French scientist, has discovered that a thread, one yard long, will support by its own buoyancy in the air the weight of a young spider. It would thus be in the power of a juvenile to spin a thread of that length and trust to air currents to carry it across and attach it to an opposite bush so that he himself could then pass over and draw it tight. But many of these threads, to judge from their strength and consistency, are not the work of young spiders, and, as every observer knows, they are often many yards long and drawn so tightly that the face is instantly aware of their presence when breaking them.

The work is nearly always done in the night time, so that observation is difficult.

If the spider had any human nature in his make-up—and many of his habits would lead us to suppose that he has—he would be gratified at the perplexity which he causes and would advertise his performances as zealously as do less gifted human gymnasts and even some popular preachers.

© 1902 SCIENTIFIC AMERICAN, INC.

SOME MODIFICATIONS OF THE NORMAL PHOTOGRAPH.

BY GEORGE M. HOPKINS.

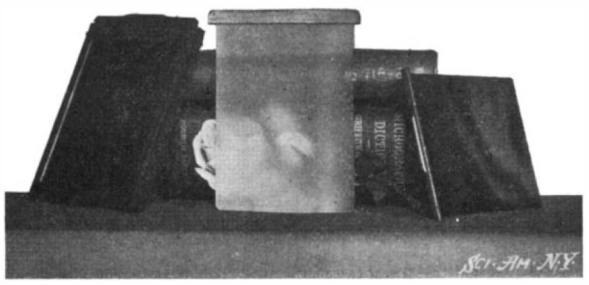
The amateur photographer begins with an ordinary camera, becomes dissatisfied and procures a better one, and frequently proceeds in the same manner until he is satisfied that he has secured the best instrument that can be obtained. It cuts the photographic image from the center to the edge of the plate with fidelity, and he derives great satisfaction in possessing as good a lens as can be made. But before very long he learns that a picture photographically perfect lacks a great deal in true artistic feeling and quality, and he begins to remedy the defects of the perfect lens by throwing the plate out of focus, or by using a larger stop, or both, and thus secures to some extent the broad effect that he has learned to admire.

In addition to following out these suggestions he may produce artistic effects in other ways which recommend themselves to the experimenter in photography. One of the simplest methods of obtaining a soft ethereal effect consists in interposing between the lens and the plate a piece of ground glass, glass coated with ground glass substitute, or ground glass celluloid, placed at different distances from the plate, according to the effect desired. A very good scheme is to withdraw the slide from the plate-holder and replace it by a slide of translucent ground glass celluloid, like that shown in one of the illustrations, taking care to exclude the entrance of light by changing the slides under the focusing cloth, the exposure being made through the ground glass celluloid. The resulting picture, whether portrait or landscape, is soft in outline, and is possessed of mellow lights and shades. The finer details of the photographic image are omitted, and the much-desired breadth is secured. If broader effects are desired a square of finely-ground glass can be placed in the camera within or inside of the reversible back. Of course, the farther the glass or celluloid is removed from the sensitive plate the more details are omitted from the negative. If it is desired to show more of the detail than is possible with a translucent slide of the kind described a thin sheet of crystal glass of the size of the plate may be coated with ground glass substitute and placed in the holder along with the plate, with either the film or coated side out, according to the effect desired. The ground glass celluloid when placed either side out in contact with the sensitive film produces a desirable effect. If it is difficult to get ground glass celluloid a piece of fine, thin tracing paper may be secured by its corners to a thin piece of glass (an old negative glass, thoroughly cleaned will answer). The effect will be quite broad if the glass side is placed next the sensitive film, and the negative will be very soft if the tissue paper is placed next the sensitive film. These interposed films absorb more or less of the light, and necessitate an increased exposure, but the increase is very slight and can be determined only by experiment in each case. A lantern slide produced from a negative of this kind, if well colored, appears on the screen more like a painting than a photograph.

Another peculiar effect is secured by placing over the sensitive plate a thickness of fine, thin muslin stretched over a frame of common tin, or thin brass plate, the frame being placed in the holder along with the plate. The muslin should be wet when mounted and secured to the frame by stratena or some other adhesive cement. Broader effects may be produced by removing the muslin screen to the reversible back.

Lantern slides printed from ordinary negatives through fine ground glass, or ground glass substitute, lend themselves beautifully to coloring, as they are broader and more like paintings than other colored slides.

A painter who dislikes to copy an ordinary photo-



TRANSLUCENT SLIDE.

PHOTOGRAPH TAKEN WITH TRANSLUCENT SLIDE.

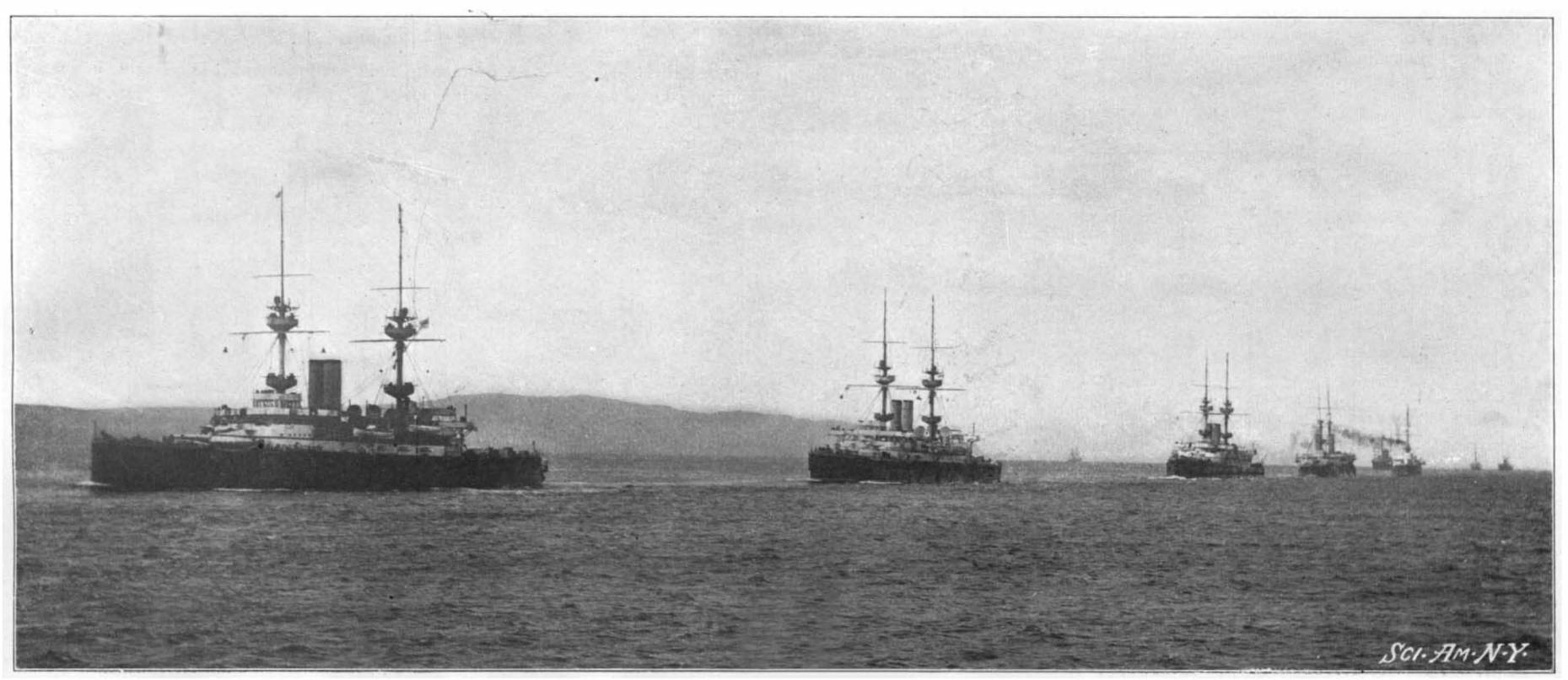
graph, on account of the difficulty of omitting detail, will find a copy of a good photograph taken through ground glass or tracing paper much more agreeable to follow than the photo with its many details. Half-tones may also be copied in this way.

This may seem to the ultra-photographer, who takes the greatest interest in sharpness, depth and multitudinous detail, as a retrograde movement, tending toward the degradation of photography, but the true artist will find use for photographic pictures with reduced detail.

THE CORONATION NAVAL REVIEW.

As far as the numbers and strength of the British ships were concerned, the postponement of the coronation naval review detracted nothing from the splendor of the naval pageant of August 16; although the necessity for the withdrawal of most of the foreign warships caused the event to lose some of its international character. The only foreign ships that were present at the review were the Japanese armored cruiser "Asama," of 9,700 tons displacement, and the 4,180-ton protected cruiser "Takasago," with the Italian armored cruiser "Carl Alberto," of 6,500 tons, and the 4,100-ton Portuguese cruiser "Dom Carlos I." Outside of these four vessels the great fleet of 103 ships was marshalled from the British navy, without withdrawing a single vessel from the Mediterranean or any foreign station or from the reserve fleet. The ships were those of the Channel squadron, the Home or Defense fleet, and the Cruiser squadron, the last named being the latter-day representative of the famous Flying Squadron which was organized when Emperor William sent his famous message at the time of the Jamestown raid. Of the 107 vessels present, 4 were foreign ships, 20 were battleships, 24 were cruisers and the balance was made up of torpedo-boat destroyers, torpedo boats and other miscellaneous craft. The fleet was anchored in five long lines which covered some 25 square miles of the sea, the line of visiting yachts being drawn up in position at the southeastern end. The battleships line included such vessels as the "Prince George," "Hannibal," "Jupiter" and "Majestic," with the "Trafalgar," "Nile," "Royal Sovereign," and other vessels of from 12,000 to 14,900 tons displacement. The most modern and formidable of the cruisers was the armored vessel "Sutlej," of 14,000 tons and 23 knots speed. She was followed by the "Narcissus," "Galatea," "Niobe," "Crescent" (late flagship of the North Atlantic squadron) and the "Endymion." A one-gun signal from the battleship "Royal Sovereign" at 2 o'clock announced the departure of the King in the new yacht "Victoria and Albert" from Cowes. The crews of the fleet at once manned shipped and simultaneously from over 100 vessels there thundered forth a salute of twenty-one guns, the firing being taken up by the shore batteries and the crash of artillery lasting for at least a quarter of an hour. The royal yacht then passed up and down the lines, and at 4 o'clock, at the finish of the review, as she came to her moorings escorted by a flotilla of torpedo-boat destroyers, another royal salute was fired. At night every vessel in the fleet at a given signal burst into a blaze of electric lights, the scheme of illumination consisting of a row of incandescent lights at the water line and at the upper deck, the outlining of the masts and funnels by similar lines of light. This was followed by an elaborate colored searchlight display by every vessel of the fleet, which formed the closing feature of the day's festivities.

In the accounts of the review cabled over to this country there has been a great deal of misleading criticism, which would lead the public to infer that the quality and efficiency of the British navy is in the inverse ratio of its numbers. As a matter of fact, the vessels engaged in the review were not by any means the most modern and formidable in the British navy, the battleships, for instance, and most of the cruisers having been designed nearly a decade and a half ago. Hence, it is entirely misleading to compare the vessels present at the review with foreign vessels which have only just been turned out from the builders' yards. These battleships are of the same date as our "Oregon" and "Massachusetts." The



British Battleships Proceeding [illegible]head in Column of Line Ahead,

THE COROl[illegible]N REVIEW.

© 1902 SCIENTIFIC AMERICAN, INC.

latest vessels of the British navy were, as has been mentioned above, doing duty on the Mediterranean and foreign stations, from which they could not be spared, even for such an important occasion as the coronation of the King.

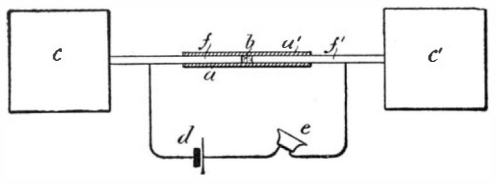
ELECTRICAL RESONANCE AND ITS RELATION TO SYNTONIC WIRELESS TELEGRAPHY—II.

BY A. FREDERICK COLLINS.

(Continued from page 120.)

Having developed the theory that light and electric or Hertzian waves are electromagnetic and that both originated from the same cause and are propagated by the same medium, the next step toward the new art of wireless telegraphy was when Branly observed

FIG. 4.



that electric waves acted on metal filings very much like light waves on selenium, i. e., lowered its resistency; these filings were placed in a glass tube for convenience in operating, and to its evolution is largely due the practicability of the wireless telegraph. Branly's radio-conductor, as he named the tube, entirely supplanted the wire-ring detector of Hertz, owing to its wonderful sensibility to the electric waves. Lodge renamed this electric eye a coherer, which has almost entirely supplanted its original appellation of radio-conductor. The coherer with battery and telephone receiver shown diagramatically in Fig. 4 is the fundamental receiving apparatus required for wireless telegraphy.

WIRELESS TELEGRAPHY.

The apparatus employed in wireless telegraphy consists of the Ruhmkorff coil and oscillator, as in the Hertzian experiments, but with the addition of a long vertical wire or antenna, suspended from a mast, its lower terminal connected with one arm of the oscillator; a second wire leading from the opposite oscillator arm to a sheet of metal in the earth. Fig. 5, *A*, shows the arrangement. The receiving device consists of the coherer with a vertical wire leading from one of its conductor plugs to a mast as in the transmitter; the opposite coherer conductor plug is connected with an earthed plate of metal. In series with the coherer are a battery and relay, and in an auxillary circuit are placed the tapping device to decohere the filings in the tube and a Morse register for recording the messages on tape. The receiver is illustrated in Fig. 5, *B*. Now when the waves are emitted by the transmitter, *A*, at a distance from the receiver, *B*, they are propagated through the electro-magnetic medium or ether, and every impinging wire on the vertical wire attached to the coherer, *B*, decreases its resistance from thousands of ohms to a few tens or even less; the resistance of the circuit, including the coherer, battery and relay is now reduced sufficiently to offer little opposition to the current from the battery, the relay armature is drawn into contact and actuates the circuit controlling the register.

RESONANCE.

With this brief description of the *modus operandi* for wireless telegraphy it will be interesting to ascertain the laws governing the electrical resonance effects between the transmitter and receiver and the apparatus necessary to transmit waves to "any one or more of a number of different instruments in various localities." This is accomplished by prolonging a series of rapid electric oscillations of a particular frequency on the transmitter and having the receiving circuit so balanced in its coefficients of inductance, capacity and resistance as to respond to that frequency or some multiple or sub-multiple of it. This is clearly shown in the case of Lodge's syntonic jars. Fig. 6, *A*, is a Leyden jar, 1, having a spark-gap, 2, and a circuit formed of a rectangular conductor, 3. At *B*1, is a second Leyden jar of equal capacity to *A*1, a spark-gap, 2, of microscopic size and a circuit, 3, made variable by the sliding wire, 4. If the jar, *A*1, is now charged and then discharged through the gap, 2, oscillations will be set up in the circuit, *A*3, of definite frequency and if the inductance capacity and resistance of both circuits, *A*3 and *B*3, are equal, then oscillations having the same periodicity will occur in *B*3. The scale upon which these experiments are made may be greatly extended; the Ruhmkorff coil and Hertz oscillator may be substituted for the Leyden jar at *A*1, and a coherer for the micrometer spark-gap of *B*2. But in substituting these essential factors two great difficulties are encountered; first, an open circuit, i. e., Hertz oscillator, emits waves with such energy that only two or three swings of the high frequency current take place before it is *damped* out or the current

FIG. 5.

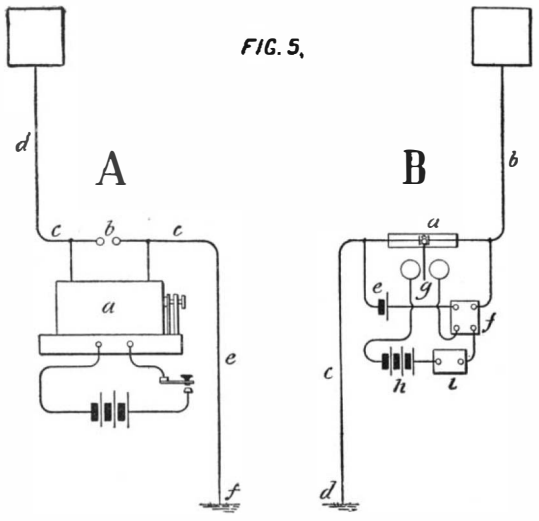
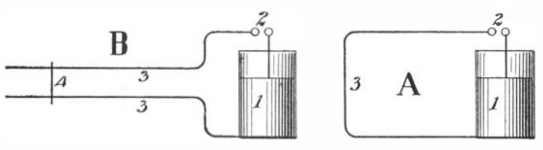
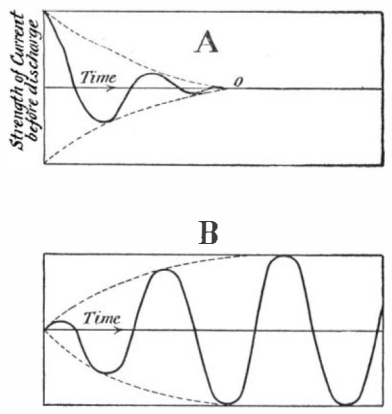


FIG. 6.



dissipated, as shown in the diagram, Fig. 7, *A*. Waves emitted by this system are propagated to great distances, but the oscillations producing them are not sufficiently prolonged to create oscillations of similar frequency in the receiving circuit. In the closed circuit oscillator of the Lodge syntonic jar type the oscillations are quite persistent and in consequence the emitted waves are very feeble; this precludes its use for commercial wireless telegraphy. Such a closed circuit oscillator will set up in a receiver in tune with it oscillations of remarkable persistency, depicted graphically in Fig. 7, *B*. The second difficulty in changing from the experimental apparatus to that required in practice is the tremendous additional capacity loaded on the oscillator and coherer circuits by connecting one arm of either to the earth.

FIG. 7.



The capacity of the earth is so great that practically all oscillators and coherer circuits are tuned or syntonized, and by inserting other values of capacities and inductances in the form of inductance coils and condensers, the value of the earthed systems is but little changed.

SYNTONIZATION.

To systems employing pure resonance effects in which both transmitting and receiving circuits are tuned by inductance and capacity, the name *syntonic* has been given. By clever arrangement of the devices the objectionable features of the closed oscillator are partially eliminated and its good features partly retained, in other words, a compromise has been effected.

The three principal syntonic systems are the Slaby-Arco, the Braun and the Marconi. The Slaby-Arco syntonic wireless telegraph is shown in diagram, Fig. 8, *A*, *B*. It is assumed by the inventors that electric oscillations in the vertical wire, 1, are like the mechanical vibrations of a flexible steel bar with the greatest amplitude at *a*, *a'*. *A*. *B*. with the ether as the connecting medium. The coherer then should be attached to the highest point of the wire, *a'*. The terminal of the vertical wire or antenna forming contact with the earth is, according to Dr. Slaby's theory, the nodal point of the electric waves. At this point a second wire, 2, having inductance and capacity equal to the wire, 1, is connected in, with the opposite terminal attached to the coherer, 3, thus the amplitude of the wave is again the greatest, and the maximum effect obtained without attaching the coherer to the upper terminal of the vertical wire. The transmitter is arranged similarly in its relation to the antenna. An adjustable condenser, 2, and inductance coil, 3, permit the periodicity of oscillation to be changed to a

FIG. 8.

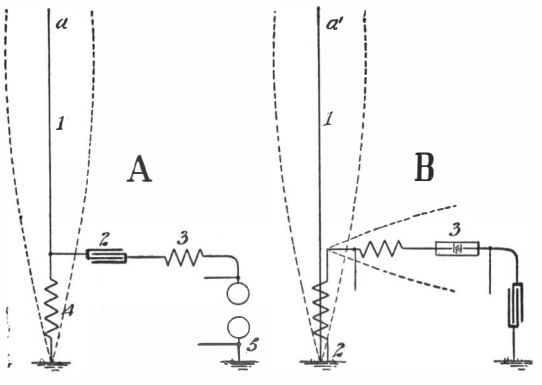
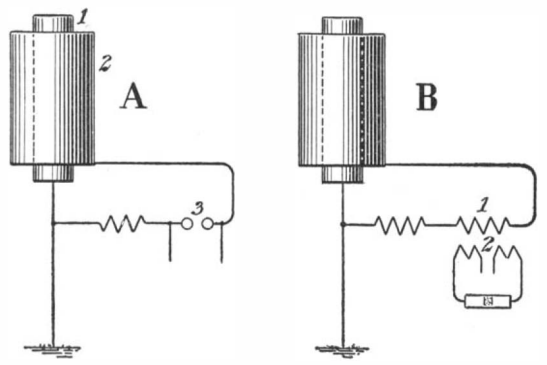


FIG. 9.

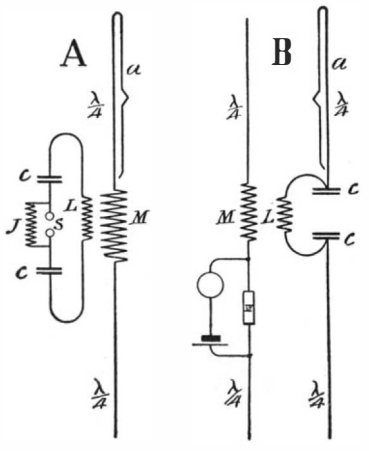


value suitable for the receiver. The coil, 4, serves to regulate the harmonies between the vertical wire emitting them and the oscillator system producing them. One terminal of the oscillator system, 5, leads to earth, which forms, virtually, a loop or closed circuit as in the Lodge syntonic jar. This system was exhibited by Dr. A. Slaby and Count d'Arco before the German Emperor in 1899 when two messages were sent and received simultaneously from different stations without interfering.

In the Marconi syntonic wireless telegraph system the feeble radiation of the closed circuit has been obviated by a widely different method from that of Slaby. Marconi has worked along the lines laid down by Lodge, producing the emitter shown in Fig. 9, *A*. It consists essentially of two concentric copper cylinders, one within the other, but separated by an insulating film of air. The inner cylinder, 1, is connected with the earth and one terminal of the spark-gap, 3. The outer cylinder, 2, is connected to the opposite terminal of the spark-gap, the whole representing a huge Leyden jar, the current surging to and fro, equalizing the difference of potential. The receiver is shown at *B*, Fig. 9. The system is arranged like that of the transmitter. One of the greatest improvements in commercial apparatus is that of the transformer coil shown, 1, 2. The coherer, instead of being placed in the electric wave system direct, is arranged in a separate circuit. The free periods of the oscillations set up are not affected by the high resistance of the coherer, and the oscillations may be stepped up or stepped down, as in the case with commercial alternating current transformers. This arrangement was tested between Biot and Calvi, near Nice, by Marconi, who has since fully described the equipment in a paper before the Society of Arts.

Another syntonic wireless system is that of Dr. F. Braun and has been described in the SCIENTIFIC AMERICAN SUPPLEMENT. Fig. 10, *A* and *B*, shows the arrangement of the transmitter and the receiver. *J* is the secondary of the induction coil, *S* the spark-gap, *c*, *c* condensers, and *L* the inductance primary, the whole forming a closed circuit, the oscillations being very persistent; *M* is the secondary of the transformer, and with the conductors $\frac{\lambda}{4}$ an open oscillator system is produced. This arrangement has all the advantages of the closed and open oscillators combined. The receiver, *B*, consists of the vertical wire, *a*, condensers, *c*, *c*, and the inductance coil, *L*, forming the closed circuit and the secondary, *M*, and conductors, $\frac{\lambda}{4}$ included in one of them is the coherer and receiving apparatus. The conductors marked *a*. *a*. *A* and *B*, are the antenna and all others marked $\frac{\lambda}{4}$ are of equal length, but are coiled up loosely. This system is now in use in Germany and has given satisfaction over distances of 40 miles.

FIG. 10.



© 1902 SCIENTIFIC AMERICAN, INC.

This represents the state of the art wherein the simultaneous transmission of wireless messages in the same field of force without interference is accomplished at the present time. The whole future of wireless telegraphy depends on the great problem of electrical resonance in its relation to the requirements of practice, rather than on the distance over which the waves may be propagated. Wireless telegraphy is a new art with possibilities practically unlimited when a simple, practical and sure method is attained for syntonizing the instruments. The laws of high-frequency, high-potential currents are well understood, as are those of electrical resonance, but the function of the earth being imperfectly understood has blocked the way very materially to the application of these principles.

The evolution of wireless telegraphy has been rapid and in less time than was required to perfect the telephone a system of wireless transmission of intelligence should be in operation fulfilling all the requirements of commercial usage.

THE SNOQUALMIE FALLS POWER PLANT.

BY ENOS BROWN.

The electrical power transmission plant at Snoqualmie Falls, State of Washington, if not the greatest in the amount of power produced in the far West, is in many respects, the most remarkable. The natural advantages at this point for a power plant of this kind are not excelled anywhere, and though the obstacles presented offered but little difficulty, from an engineering point of view, the skill with which every material feature of the undertaking has been subordinated in order to secure intended results, has been so masterly, as to make this famous plant one absolutely unique in the annals of like undertakings. Art has here supplemented natural forces and the result has yet to be surpassed.

Niagara is greater in many respects; less in the attitude of the fall, but presenting no problem of economical administration of the water flow; but at Snoqualmie severe questions of water storage, seasonal variations in the flow, floods and drought, had to be confronted. A combination of almost every feature embraced in transmission of electrical energy is demonstrated in this wonderful plant.

The Snoqualmie River rises in the Cascade Mountains and drains a comparatively small area, but the rainfall, from 90 to 150 inches annually, assures a volume to the stream entirely disproportioned to the extent of the watershed. Moreover, the sources of the river are amid snows, accumulated during the winter months and yielding constant reinforcements during the season of droughts. Floods pouring 10,000 cubic feet of water a second occur every season, the flow diminishing to one-tenth that amount in the month of September; but the regulation of the flow offers no difficulties. Lakes abound in the upper courses of the river with narrow outlets which, if dammed, would hold the superabundant floods and permit an ultimate and regular volume in the stream, and afford, at all times, 200,000 available horse power. At present 30,000 horse power is produced. The greater power may be had whenever the rapidly extending manufacturing interests of the country demand it.

Thirty-one miles from Seattle, the Snoqualmie descends in one leap over a basaltic rock barrier 270 feet high. Less than four years ago the scene at this point was one of wild grandeur, and forest solitude. Today, a transformation is presented. The banks have been restrained and terraced. The great pines have disappeared. Dwellings and apartments of architectural symmetry decorate the landscape, and a busy community has grown up beside the cataract.

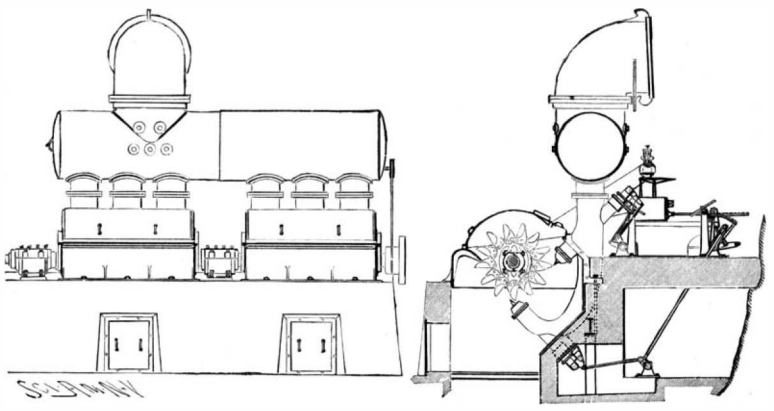
The Snoqualmie Light and Power Company was organized in 1898, and soon after surveys of the river and watershed were undertaken, and plans for their development adopted.

A dam of concrete was constructed just beyond the crest of the falls, for the purpose of raising the low water elevation of the river to a minimum depth of 8 feet. The dam is 218 feet long between piers, and varies in height from 3 to 10 feet, with a level crest 8 feet wide, sloping up and down stream, with base varying from 16 to 35 feet in breadth. The dam is strengthened by steel rails fastened into the rock bottom and projecting upward into the concrete. It is calculated, if the demand for power required it, that the present dam could be increased to a height of 50 feet, and a lake formed 15 miles in length and of an average depth of 25 feet, increasing the available power to 200,000.

About 100 feet above the dam, a shaft is sunk, 10 x 27 feet in dimensions, descending 270 feet to the level of the river below the falls. A tunnel, 12 feet wide, and 24 feet high, is driven from the face of the ledge below the falls, to intersect the shaft. The tunnel is 650 feet long with a fall of 2 feet in that distance. At the foot of the shaft, and extending over the tunnel, is a chamber 200 feet in length, 40 feet wide, and 30 feet high, excavated in the solid rock. This chamber is unique in power transmission plants, housing, as it does, water-wheels and electric generators, 270 feet underground. The tunnel underneath forms the tailrace. The floor of the chamber is of concrete, the walls are of rock, and are whitewashed. Hundreds of incandescent lamps illuminate this great artificially constructed cave. As more water-wheels and generators are required, this chamber will be continued to an additional length of 200 feet.

The main shaft has three compartments; an elevator in the center, with a chamber for the great cables, and a penstock on each side. The steel bulkhead composing the central shaft extends from the surface to the chamber below, and is built of steel plates strengthened by horizontal bars on the outside. The penstock is a steel pipe 7½ feet in diameter, passing through a concrete roof, which keeps the shaft watertight. The plates are in eight-foot courses, 1 inch in thickness at the lower half, and decreasing to ⅞ and ½ inch. The joints are heavily riveted and calked. At a depth of 250 feet the penstock reaches the chamber and connects with a horizontal, cylindrical receiver, which rests on a rock bench at the side of the chamber, 12 feet above the floor for almost the entire length. The diameter of the receiver varies from 10 feet for half its length, to 8 feet for the balance. It is built of 1-inch plates. The weight of the penstock and receiver is 225 tons, and the weight of the water column in the penstock is 340 tons.

Water is taken direct from the river into the intake, a massive chamber of concrete with walls 25 feet high, and 6 feet thick. To keep out floating obstructions the front of the intake is protected by a grating of 12 x 12 timbers with a 12-inch space between each. The headbay is further protected by a screen of flat, steel bars for keeping out small debris. In the chamber are installed four wheel units, each developing 2,500 horse power, and directly connected to its generator. The vessels are of the tangential type. The receiver has four supply openings controlled by individual double-screen gate valves, of 48 inches inside diameter, weighing 23,000 pounds each. This receiver is horizontal, and the openings are on its side, and open toward the cavity. Bolted direct to the gate valve is an elbow casting that directs the water downward into the distributing receiver. This elbow is 48 inches inside diameter, and is bolted directly to the flanged opening of the distributing receiver. The water flowing into the receiver is discharged from the six openings along the bottom, into the six multiple nozzles that direct and regulate the water that is applied to the wheels. The six wheels are divided into two groups of three, each being in a separate housing, with a bearing between. Regulating lips are used on the nozzles, which throw a perfect and unbroken stream and are controlled by a governor. The wheels are 45 inches in diameter, with thirteen buckets each. The weight of each unit is about 100,000 pounds, exclusive of the weight of water in the receiver house. The foundations were required to be of a massive and substantial character. The tailrace is beneath the foundations, so that the water drops into it from the wheels and flows out into the river below the falls.



FRONT VIEW AND CROSS-SECTION OF RECEIVER AND WATER WHEELS OF THE SNOQUALMIE POWER PLANT.

The generators are of the revolving armature type and deliver a 3-phase current; each weighs 100,000 pounds and stands 14 feet high. The armature winding consists of 266 bars with one bar to each slot and is closed-circuit winding. The speed is 300 revolutions per minute.

There are provided two separate 125-volt exciters, each of 75 kilowatts, driver a 100 horse power wheel mounted on steel h

From the feed panels of witchboard 24 alumi- nium cables are provided f ducting the 1,000-volt current up the elevator sha e transformer. The transformer house is firepr d is 40 x 60 feet in dimensions.

The character of the traversed by the transmission line is, gene speaking, mountain- ous, though in places, flat lling. Daily inspection is made of the line's condition. The right of way is cleared for a distance of 300 feet on each side of the line. The transmission lines are of aluminium. The conductivity of this metal is 60 per cent that of copper, and consequently the cables are 66 per cent greater in cross section than copper cables of the same capacity. Even at the increased size the saving in weight by the use of aluminium is nearly 50 per cent. The cost also is less.

The terminal station at Seattle is located in the business district and is a building of large dimensions and of considerable architectural pretension.

The street railroads of Seattle, many manufactories, beside public and private lighting, are supplied by the Snoqualmie Company. Tacoma, a city of 40,000 inhabitants, which is supplied from the falls, is also provided with a large and fully equipped substation.

The next move will be to connect with the city of Everett with its population of 10,000 and extensive lumbering establishments. This work is now in hand.

More News of the Galileo Ferraris Award.

The commission for the Galileo Ferraris award, which was instituted in 1898, composed of representatives of the Executive Committee of the Association of the General Italian Exposition, in Turin, 1898, of the Chamber of Commerce and Arts, of the Royal Academy of Sciences and of the Royal Italian Industrial Museum of Turin, has decided to reopen an international competition for the conferring of this premium on the occasion of the inauguration, which will take place in the second half of September next, of the monument to be erected in Turin to this illustrious scientist.

The premium consists of 15,000 lire and interest from 1899 up to the date of the assignment, and will be conferred upon the author of any invention from which results a notable progress in the industrial applications of electricity.

Competitors can present papers, projects and drawings, as well as machines, apparatus or constructions relating to their inventions.

The jury nominated by the association above named will have most ample powers to execute practical experiments with the inventions presented.

Competitors must present their requests and deliver their works, machines, apparatus or anything else connected with their inventions, not later than the 18th day of September, 1902, at the office of the secretary of the association, which office is located at the administrative committee headquarters of the First International Exposition of Modern Decorative Art, 1902, in the palace of the Chamber of Commerce and Arts of Turin, via Ospedale, No. 28.

The "Cedric" Launched.

The new steamship "Cedric," built by Messrs. Harland & Wolff for the White Star Line, was launched at Belfast on August 21. She is a vessel of 21,000 tons gross. Her length is 700 feet and she is 75 feet beam.

Tunnel Signals for the New York Central Railroad.

The New York Central Railroad has tested the experimental installment of the Miller visible engine signal and direct-circuit on all its trains running through the Park Avenue tunnel. The test is said to have been very successful, the engine signals working perfectly and duplicating the block signals. There are two sets of signals in the cab of the engine, one in the front and the other in the rear, to be used when the engine moves back. When the track is clear a white light is displayed, but as soon as danger threatens, the red light in the lower bulb glows red, no matter what the indications of a block-signal may be.

The Current Supplement.

The current SUPPLEMENT is replete with articles that cover almost every field of science. The naval architect will read with interest the description of the building of the battleship "Nebraska," and Mr. Fred T. Jane's shrewd criticism of the "Belleisle" experiment and his study of an ideal conning tower. Engineers will doubtless appreciate the discussions of experiments on railway and road bridges and a description of the largest hydro-electric plant in Europe. Of no slight importance is a copiously illustrated account of the Meray-Rozar electrotypographic machine, as well as a report on the international exhibition of alcohol motors. Other articles of interest are Mr. Henry's paper on Chinese drugs and medicinal plants, and an account of physiological effects of diminished air pressure. "Psychological Apparatus" is the title of an interesting essay. Mr. Mason's monograph on the harpoon is concluded. That the Trade Notes and Selected Formulæ also find their place in the current SUPPLEMENT goes without saying.

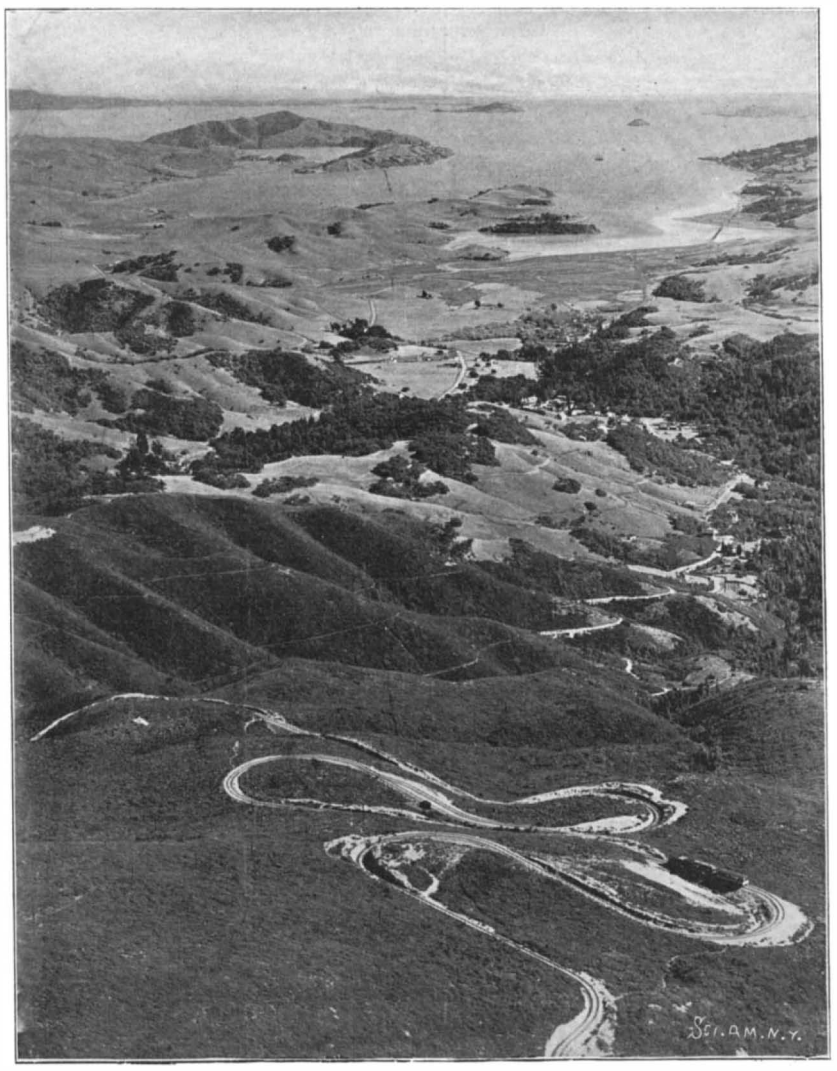
© 1902 SCIENTIFIC AMERICAN, INC.

REMARKABLE ENGINEERING FEATS IN RAILROAD WORK.

BY CHARLES F. HOLDER.

The modern plan of reaching high mountains, typified by the Rigi, the road up Vesuvius, the Mauch Chunk, Pike's Peak and Mt. Lowe roads, has been put into operation with much success at Mt. Tamalpais, north of San Francisco. This mountain forms one of the sentinels of the Golden Gate, rising directly out of a thickly-wooded country which one hundred years ago boasted some of the finest and largest redwoods in the entire range. Mt. Tamalpais has long been famous as the only lofty mountain in the immediate vicinity of San Francisco. Reached by a hard trail, but fully repaying the climb, the view is grand and impressive; the ocean stretching away on one side, the Golden Gate at its feet, and to the west the summits of tall mountains piercing the sky.

The approach to the mountain is from the bay, in the vicinity of which are many attractive places, as Sausolito, San Rafael and the little bays which have become noted for the houseboat fleet of San Francisco. The foothills of the range are extremely steep and cut by many cañons—a peculiarity of Californa mountains, each hog-back, or divide, having numerous lateral cañons, all of which are deep but well wooded. No little ingenuity was necessary in solving the engineering problem to make a possible ascent, but in the accompanying illustration it will be seen that the work was accomplished by a remarkable series of long reaches and gradual ascents up the sides of the largest cañons, and finally by a succession of loops known popularly as the bow-knot. Coming up out of the cañon which it has crossed, at the head, the road sweeps to the west, turns to the east, making another end to the bow, then quickly turns backward and downward to rise and complete a second bow, during which it proceeds on a regular grade to the summit, from which the traveler looks directly down upon the winding and circuitous track which has solved an exceedingly difficult problem in mountain climbing.

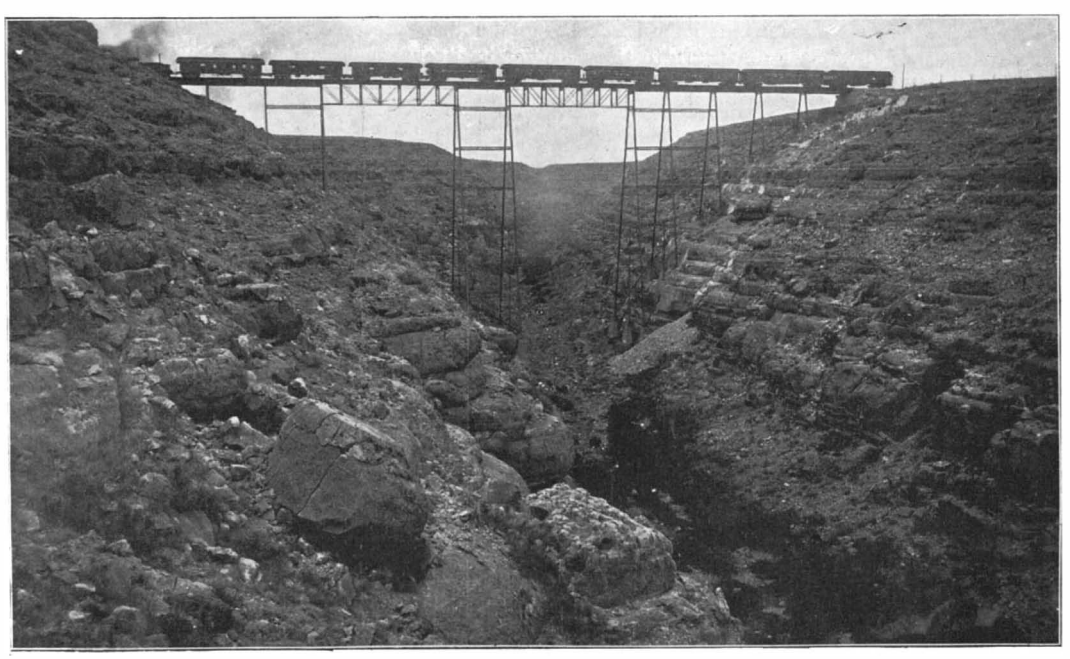


VIEW LOOKING DOWN THE MOUNT TAMALPAIS RAILROAD, SAN FRANCISCO.

Among the interesting, indeed striking, engineering feats of the West, is the bridge of the Atlantic and Pacific Railroad crossing Canon Diablo, which has long been noted in the engineering world. The photograph here given shows the train in the act of spanning the bridge, completely filling it, and from the middle car the view down into this remarkable gorge is awe-inspiring, the cañon being a miniature Grand Cañon. The bridge is carried on ten piers.

The Cañon itself is extremely interesting, appearing on a vast mesa without apparent cause, worn out by the rushing water of ages, the remarkable strata telling that at one time the ocean swept over the locality. Not far from the Cañon Diablo one of the largest meteors known fell some time in the past, and among the natives there is a legend that it struck the earth at the head of the cañon and ploughed out the vast fissure as it is seen to-day. Unfortunately scientific investigation does not bear out the fact, and the meteor story merely stands as a picturesque feature to be repeated to the visiting tenderfoot. Hundreds of specimens, or fragments of this gigantic meteor, have been picked up from time to time.

Another interesting bridge is that which crosses the Rio Grande in Texas, constructed by the engineers of the Southern Pacific Company, being remarkable for its expanse and height, and adding to the attractions of the road. Not far from the Rio Grande the writer observed from the train a valley which might well have been named the father of dust spouts. The valley appeared to be about three miles in width, rising gently to the north for several miles and entailing a heavy grade, so that the train was some time in passing. At least ten lofty dust spouts were seen—majestic pillars as large as water spouts sailing down the valley from the north, finally being dissipated or destroyed by some counter current, others continually forming at the upper end of the valley. The latter was arid and sandy—a picture of heat and desolation—and the "spouts" were due to some peculiarity of its formation.



CANON DIABLO VIADUCT ON THE ATLANTIC AND PACIFIC RAILROAD.

The Greatest of All Oil Wells.

The recent oil strike in Texas has aroused so much interest throughout the country, that a brief description of the greatest oil well will not be out of place. The well in question was opened last year in the Bibi-Eibat fields in Russia. According to the United States consul at Batum, this well, during the first two or three days after it was struck, surpassed all records. As many as 180,000 barrels of oil have been taken from it during a day. It continued flowing until it produced over 2,000,000 barrels, when it stopped. Another big well was struck in the Romani district, which produced nearly 1,000,000 barrels in December and was still flowing about 25,000 barrels a day up to January 31, the date of the consul's latest information. Such a strike in the United States would mean millions to the fortunate owner of the well. But it seems it is not so in Russia. On this point the consul says:

"I think it is sufficientl interesting to mention that it is generally believed that the owners of the big well which produced mo.e than 2,000,000 barrels in a little more than thirty days lost money by it. Without explanation, this seems impossible. The fact is that the well is on government territory, leased at a fixed royalty of 5 kope s (2.5 cents) per pood (36.112 pounds), and the owners of the well realized very little above that figure for their production. Furthermore, they were compelled to pay heavy damages to neighboring property owners and to owners of property in the village, more than a mile away, as part of the time the well was flowing there was a high wind blowing, which carried the oil over the village, and, it is said, the owners of the well must pay for repainting about all the houses in the village. One-fourth to one-half a kopeck per pood does not go far toward damages of this sort. I must add that this was not the first time the village mentioned was damaged by a flowing well, as some years ago a well was struck in the Bibi-Eibat field which acted in the same manner, the wind carrying a spray of oil to the outskirts of Baku, about two and a half miles, and deluging the village which lies between Bibi-Eibat and Baku. The newspapers stated at the time that the owner of the well had to pay damages amounting to $50,000, as he had to pay for repainting the entire village, including a fine Russian church."

As the big wells recently struck in Texas have attracted so much attention, the consul gives particulars as to the depth and finishings of the great Russian gushers. The Bibi-Eibat well is 1,813 feet deep, and is finished with a 14-inch pipe. The Romani well is 1,841 feet deep, and is finished with a 11¼-inch pipe. The following comparison made by the consul of the cost of production in the Russian oil fields, as compared with the cost in the United States, is also interesting:

"The increased depth of drilling not only increases the first cost of the wells, but adds steadily and materially to the cost of raising the oil by pumping, because pumping at Baku is not done as in the United States—by means of rods and working barrel—but the oil is baled out with what is known in the United States as the bailer; but at Baku this instrument is, of course, much larger than is commonly used in the United States, as its diameter is as large as will run easily inside the pipe in the well, while its length is generally between thirty and forty feet. Of course, the deeper the well the longer, and, consequently, the fewer the runs of the bailer. Then, cleaning out, deepening, and repairing wells is a big expense. The wells are generally long lived, but require as much more expense to keep them in order than American wells, as they cost more originally. They cannot be pumped as steadily, and, consequently, there are fewer pumping days in the year."

The consul says that while the experiment of raising oil by means of compressed air is still an experiment, some of the foreign companies are equipping their wells in part with air compressors, which, he understands, are manufactured in the United States.

A Swedish invention which ought to have a good future is a system of oiling piston rods, cylinders, slide rods, and slide guides on locomotives, which has been invented by T. F. Malmros, of Gothenburg, locomotive engineer on the State railroads. Formerly cylinders and slide guides have, at best, received necessary lubrication from the central steam-lubricating apparatus, but piston rods and slide rods with packings have been lubricated by means of old-fashioned oil cups, with wick feed, which method, for many reasons, has proved unsatisfactory—especially when metal packings are used. Mr. Malmros, by introducing intermixed oil and steam, coming from the central steam-lubricating apparatus, through gland bushings expressly constructed for this purpose, has effected a good and economical lubrication of packings and rods, as well as of the cylinders and slide guides. The system has for five years been tested on one of the express engines of the State railroads—used for the fastest train in Sweden, with a speed considerably exceeding 37 miles per hour—and with good results. The State railroads have applied the new lubricating system to a number of the old and new locomotives

© 1902 SCIENTIFIC AMERICAN, INC.

THE UNITED STATES NAVAL OBSERVATORY AT WASHINGTON.

BY FREDERICK MOORE.

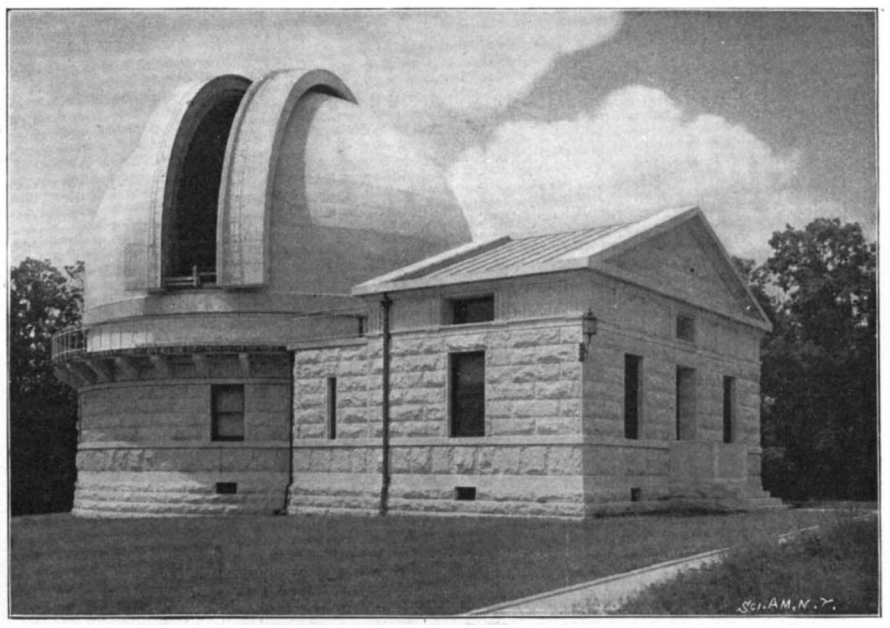
The United States Naval Observatory is the youngest among the great astronomical institutions of the nation, but it has developed in a remarkably brief time into one fit to rank with Greenwich and Poulkowa. We hear less of it, however, than we do of many of the private institutions in this country, for its object is not the further discovery of the unknown, but the development and application of the known. Of course, the former is the more brilliant object, but it would undoubtedly incur an expense to the government greater than the value of the discoveries. When a discovery is made, if it is of any importance, it has to be followed up and elaborated upon before it can be made useful to mankind. Here comes the hard work which the world does not see and here the great majority of astronomers fail.

Unfortunately the class who can see and feel the consequence of the astronomer's labor is extremely small, and it is but little realized that a second of error in a ship's chronometer at the equator means a variation of 16 2-3 miles east or west of the mariner's calculation of his position.

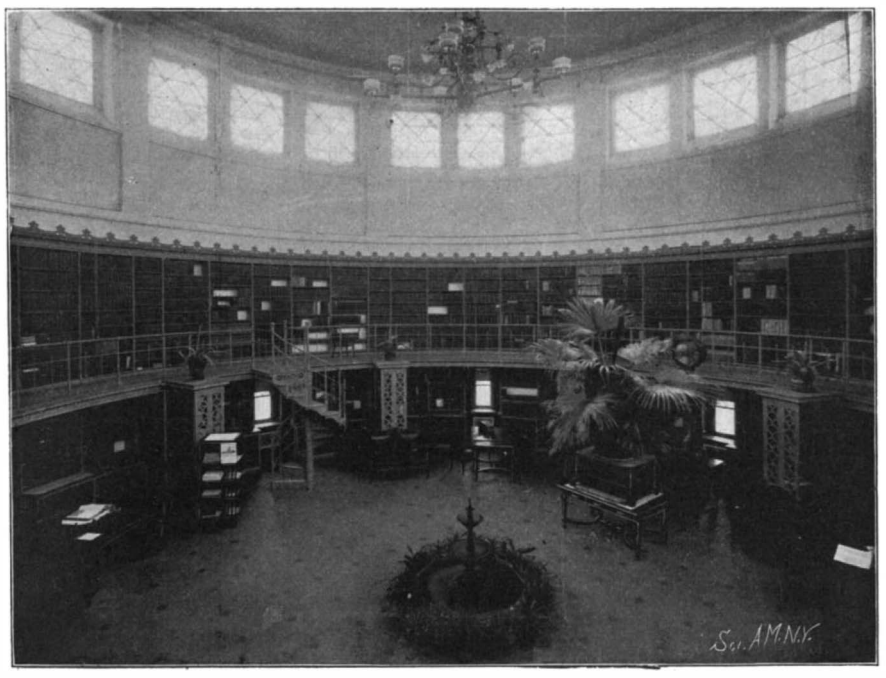
Recently great changes have occurred in the scientific staff of the institution by the retirement of the older professors, notably Doctors Newcomb and Hall, and the succession to their responsibilities of a younger staff, comprising Profs. Skinner, See, Updegraff, Eichelberger, Littell, and Prof. Harshman, Director of the Nautical Almanac.

It is remarkable that although in scientific achievement this country has led the way since its incipiency, it eked out the first sixty years of its existence, and attained some mighty marine achievements, practically without so indispensable an institution as a naval observatory. We depended on Greenwich, Poulkowa and Paris, and on college observatories here almost entirely until 1842.

Few visitors to Washington in the early days of the past century did not have pointed out to them from the north door of the Senate wing of the Capitol the site of the old "Washington property." The house named in our first President's will stood near the old Capitol until both were burned in 1814 by the British vandal, Cockburn. Close on this well-remembered site, stood, in 1833, an unpretending wooden structure 16 feet square, erected at the expense of a lieutenant in the navy, and equipped with a 5-foot Troughton Transit. This was our Naval Observatory in embryo. The transit was one of the instruments made for the Coast Survey under the direction and supervision of Mr. Hassler, its first superintendent, during his long detention in England throughout the war of 1812. Under an act in 1807 the institution was established, but the appointment of the superintendent did not take effect until 1811. While on a visit to London to secure instruments, then so slowly constructed, he was detained. The survey was arrested by Congress soon after his return and the instruments he had procured and the "fixed observatory" remained in statu quo. In 1832 the Coast Survey was revived, but an observatory was peremptorily forbidden by law. The transit was loaned, then, to Lieut. Wilkes for his "observatory."



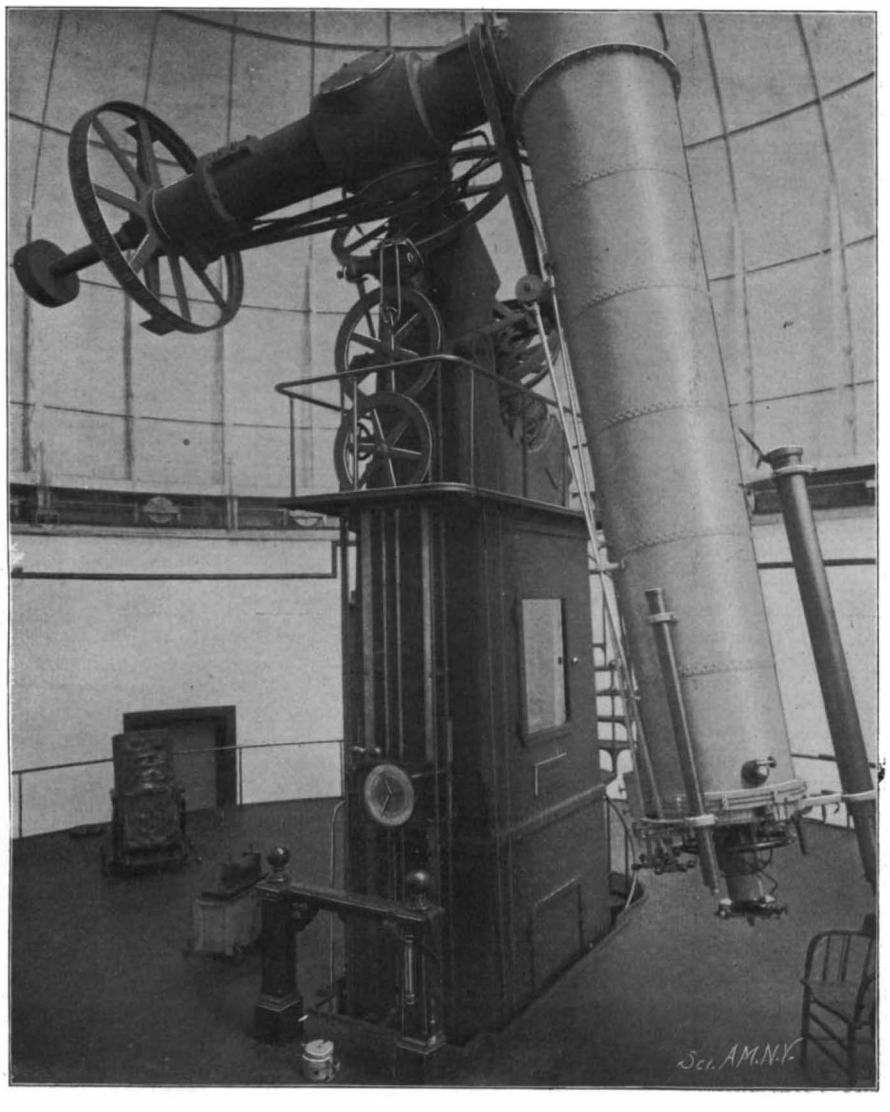
WHERE THE GREAT EQUATORIAL IS HOUSED.



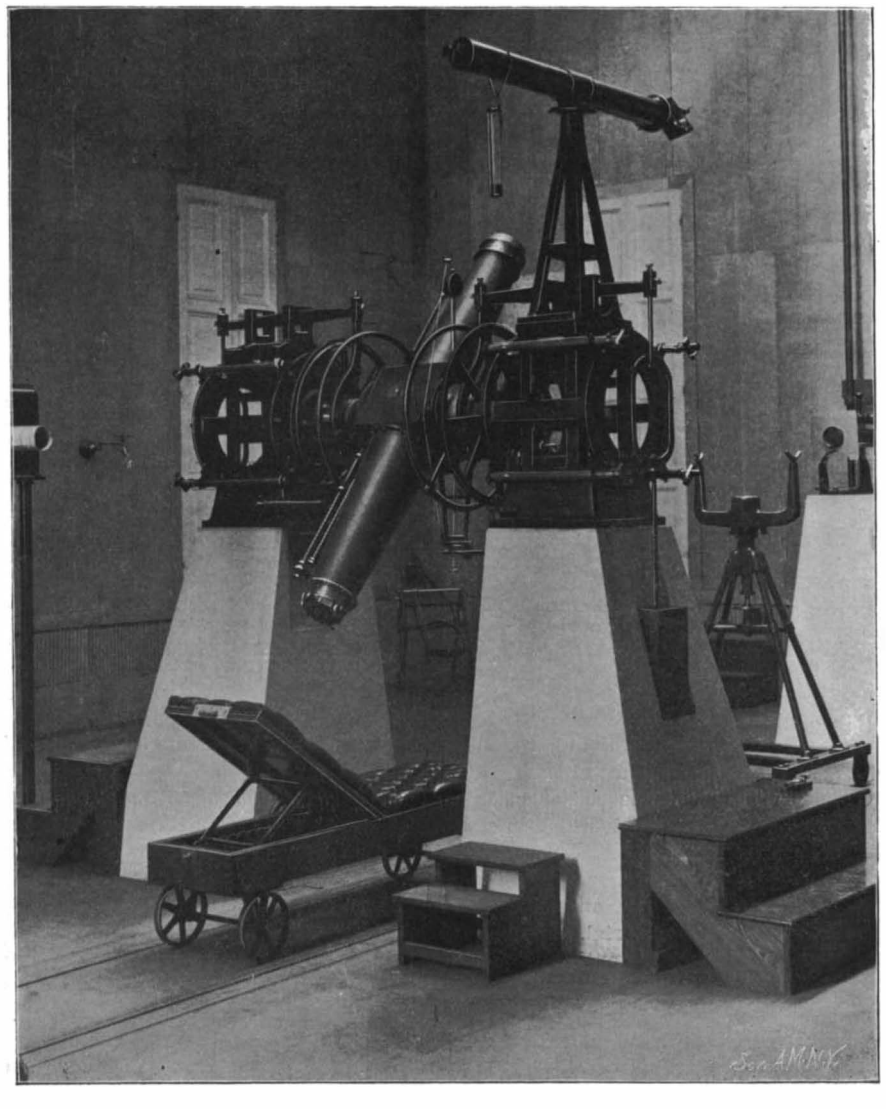
SCIENTIFIC LIBRARY OF THE NAVAL ACADEMY.

Lieut. Wilkes' observations were made only for obtaining clock errors needed for the determining of true time and the rating of naval chronometers then under his charge. The testing of all chronometers and other naval instruments used by our ships was at once found wise and useful, and the secretary of the navy took it upon himself to establish this little observatory under the name of "A Depot for Charts and Instruments," by placing an officer in charge and permitting him to have his own little observatory and do his own work. "The depot" was all Wilkes or any of his successors dared to call it until 1842, when the present institution was established.

In 1838 a new call was made upon the depot which changed the whole current of its future. An exploring expedition was about to sail for the south seas. It would be of prime importance, in determining the longitude of places visited by the expedition, that corresponding observations be taken at home to compare with those of the party, on its return. Secretary Paulding gave the observations to Lieut. Gilliss, Wilkes' successor, and Prof. Bond of Cambridge. An achromatic telescope was added to his equipment by the Navy Department and for four years Lieut. Gilliss worked diligently and accurately, bringing forth the plaudits of the



PART OF THE GREAT EQUATORIAL.



ONE OF THE SMALLER TRANSITS.

© 1902 SCIENTIFIC AMERICAN, INC.

European astronomers. He continued with his insignificant equipment until finally an appropriation of $25,000 was secured—still for a depot of charts and instruments. The observatory had been urged time and again, but for partisan reasons it was as often forbidden.

The site chosen by President Tyler was fraught with historic interest. It embraced the whole of reservation No. 4, made by the old commissioners of Washington for a national university—a favorite idea of George Washington. It was the landing place of Braddock, and at a later day was known as Camp Hill, from its being occupied by the American forces the day before their advance upon the retreat from Bladensburg. The square embraced a little over 19 acres and commanded a splendid view of Washington, Alexandria, Georgetown and Arlington.

Berlin, Paris, Greenwich and Vienna presented some 200 rare volumes of the highest standard as a nucleus for an astronomical library. This branch has grown from that to one numbering 22,000 volumes and pamphlets, and stands to-day second to Poulkawa only.

The institution grew rapidly, and in 1874 installed the largest telescope then in existence, the famous 26-inch equatorial. It was set in place just in time to observe the transit of Venus, which occurs but once in a lifetime and offers a valuable method of determining the sun's parallax (the base time measurement of celestial distances). The transit is the astronomers' great event of the century and it befell Prof. Newcomb to be in charge of the greatest telescope.

The site was soon discovered to be a bad location, because, being almost in the heart of the city there was constantly some vibration, but it was not until 1884 that appropriation and other necessary bills could be gotten through Congress for the purchase of enough ground on Georgetown Heights to properly isolate the institution.

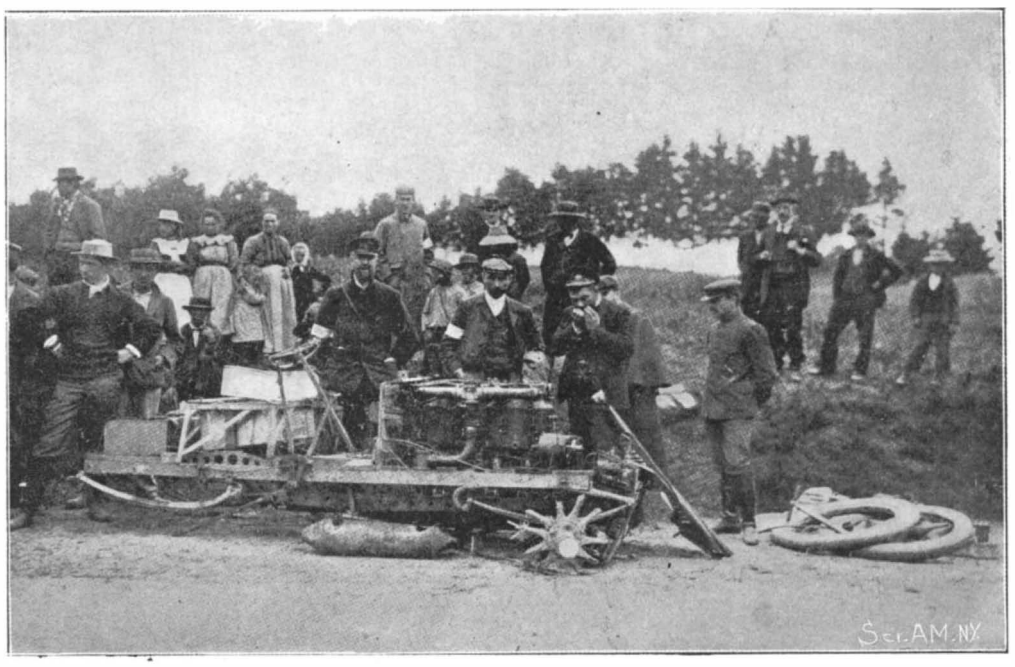
In 1893 the new home was ready for occupancy.

The dome that houses the great equatorial is a wonderful piece of mechanism. It is so perfectly balanced that its great weight of six tons can be swung or raised and lowered like a see-saw by one man without much effort. The dome rolls around on a circular wall so as to present an opening toward any part of the heavens. The whole floor rises and falls by hydraulic power to suit the convenience of the observer.

The great equatorial is in the hands of Prof. T. J. J. See, who is now at work measuring by daylight as well as by night the diameters of the principal planets and their satellites. The comparison of the daylight with the night work enables the observer to eliminate the effects of irradiation, which heretofore has been studied very little by astronomers. The light planet against the light sky of day has no irradiation as it has at night. He is also, by an elaborate series of observations in summer and in winter, making a special study of the screw of a new micrometer, designed to eliminate the effects of changes of temperature upon the scale. The degree of accuracy obtainable in this work is about one part in twenty thousand. This will give the micrometer investigation the necessary degree of refinement for the measurement of the stellar parallax, upon which he is at work also, and which is the most delicate work ever undertaken by a practical astronomer.

Beside the 26-inch equatorial, the observatory is equipped with a 9-inch transit circle, a 6-inch transit circle, a 12-inch equatorial, a prime vertical transit instrument, a 6-inch azimuth and a 40-foot photoheliograph. With this last, photographs are taken of the sun daily whenever the weather and other circumstances will permit. During last year one hundred and sixteen photographs were made of the sun. A very delicate plate with a special fine-grained lantern-slide emulsion giving contrast and fine definition has to be used, and the plates specially developed.

The effort to bring the department of meridian observations for time to a state of the highest efficiency and up to the most modern standard of requirement has included not only a recent thorough overhauling of both meridian instruments, but also an examination and improvement in the clock system. In this connection a vault was dug in the basement of the clock house, 8 feet square and 7 high. The construction of the vault is intended to be such that it will keep the temperature very nearly constant throughout the year. A 9-inch brick wall incloses the wooden house of the dimensions stated, with an air space of one foot between, which contains hot-water pipes for heating. The whole is roofed over with boards inclosing a 6-inch layer of asbestos wool. The vault contains three brick piers for clocks and one smaller pier which may be used in mounting a pendulum apparatus for testing the minor irregularities of clock rates. Triple doors are provided and means for slow ventilation. The location is on the summit of a hill, and drainage conditions are such that the basement in which the vault is situated is remarkably dry. There is little fear of damage from rust. In the early days of the observatory, in a similar experiment the clock built by Kessels, a most delicate instrument, and the most valuable of its kind in the country, was almost ruined.



THE WRECK OF JENATZY'S CAR.

An observation for time is taken about every other day. There are three standard clocks always in use and two to which the Western Union wires are attached for transmitting the noon signals. Every day, except Sundays, these signals go out. An average error of 0.13 seconds is recorded for the past year. The Kessels clock will not stand being attached to the wires, and with the others it gives the time about as accurately as it can be given. The chronometer room is maintained at an even temperature and is treated almost as delicately as is the room for the great clocks.

A NEW SCHNEIDER-CANET NAVAL GUN.

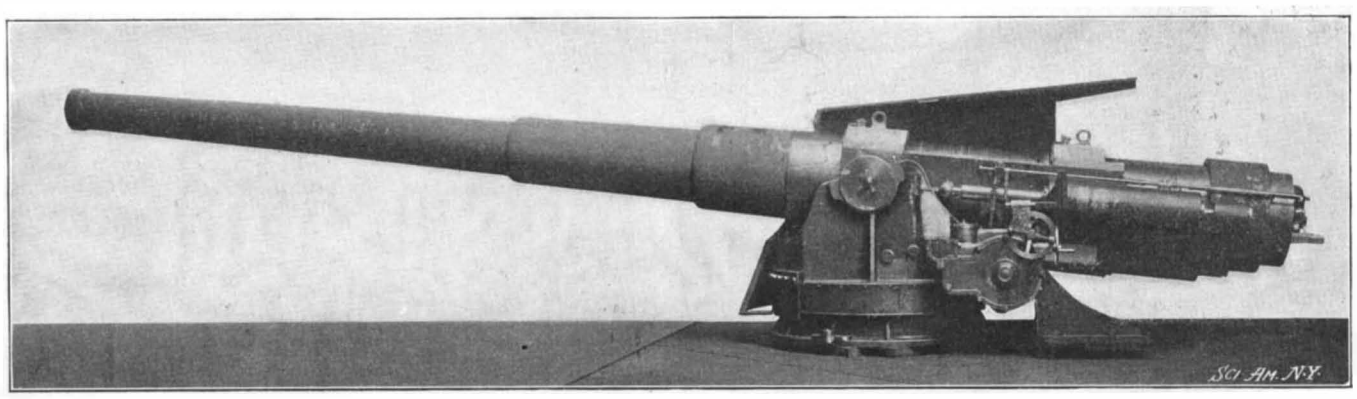
Our illustration shows a new 9.45-inch gun for naval or coast defence purposes, which has recently been brought out by the well-known French firm of Schneider & Co. The weight of the gun itself with breech mechanism is 20½ tons, while that of the carriage without the shield is 13¼ tons. The projectile used weighs 330 pounds and its initial velocity is 2,780 feet per second.

The diameter of the gun at the breech end is 36.22 inches. The breech is closed by a plastic obturator, or metallic plug, that can be locked in place or withdrawn by three and a half turns of the operating handle. Electric or percussion firing is employed as desired, with single control on the left of the gun-carriage. This mechanism is easily accessible for the gunner, who is suitably protected against premature discharges.

The gun-carriage is of forged steel and carries two diametrically opposite recoil cylinders, as well as a compressed-air recuperator, which is independent of them and is placed on the lower side. The recoil cylinders are suitably arranged for putting the gun out of or in battery by means of a pump. This enables the gunner to continue firing in case of damage to the recuperator, whatever may be the angle of elevation.

Vertical aiming is facilitated by the interposition of live roller rings between the trunnions of the carriage and the trunnion bedplate of the frame. The elevating hand-wheel, which is placed conveniently for the gunner, drives a toothed sector fastened to the carriage, by means of an endless screw and special helicoidal wheel furnished with friction packing washers to avoid shocks when firing. Horizontal aiming is accomplished by the traversing of the whole carriage, which turns on a ball-bearing traverse base ring. It is traversed by a hand wheel turned by the gunner. This wheel is connected with a pinion that meshes with a circular rack fastened by means of an irreversible mechanism of great efficiency. This mechanism, while assuring the absolute irreversibility of the system, permits of one man revolving the movable weight of 40¾ tons at a sufficiently rapid rate to follow an object moving at a speed of 34 knots and distant 1,640 feet.

Finally, this new 9.45-inch gun on a naval carriage offers the same facility of manipulation as has heretofore been obtained with rapid-fire guns of smaller bore.



SCHNEIDER-CANET 9.45-INCH GUN ON NAVAL MOUNT.

Weight of Gun, 20.5 tons. Weight of Projectile, 330 pounds. Initial Velocity, 2,780 feet. Muzzle Energy, 17,748 tons. Theoretical Perforation of Iron at Muzzle, 32.8 inches per second.

THE ARDENNES CIRCUIT.

With the completion of the *Circuit des Ardennes*, Englishmen have again scored a signal victory. The winner of the race was Mr. Charles Jarrott, who finished some nine minutes ahead of his nearest competitor, in a 70 horse power Panhard.

The race was run on a sort of huge track, measuring 85.4 kilometers to the lap, with no great grades to speak of. There were no controls, no halts of any kind to check the contestants. The race may, therefore, be regarded simply as a test of powerfully engined, high-geared cars under conditions offering the least resistance. For that reason the contest stands in sharp contrast to the hilly Paris-Vienna race.

Eighty-five kilometers in the opinion of many is a rather short lap. Indeed, the many accidents which happened in the circuit amply bear out the criticisms that have been made on this score. Pierre de Crawhaze, toward the end of a third lap, collided with M. Coppee. One wheel of de Crawhaze's car flew off, the other broke from the axle, and the car was dragged along for two hundred yards. No one was hurt. On the second lap one of Jenatzy's front wheels whirled through the air, while the car was traveling at about 65 miles an hour. The vehicle was overturned, and the driver and his assistant crawled out from under the ruins, not seriously injured. De Caters, on a Mors, was lost on the third lap in a cloud of dust raised by Jarrott, jumped on a wall, and impaled his car. On the same lap Roland in a Gobron-Brillié ran off the road and out of the race. Charron collided with a carriage at a speed of 90 kilometers an hour, and reduced his own vehicle and the carriage to splinters and scrap iron.

The race itself offered not a little excitement. It was a nip and tuck struggle between Jarrott and Gabriel. They were never more than 6 minutes apart at any of the turning points. For a long time it was uncertain whether Jarrott or Gabriel would win. At the end of the first lap Gabriel had gained two minutes; at the second he had gained one minute. At the half Jarrott led by less than half a minute. When

© 1902 SCIENTIFIC AMERICAN, INC.

the fourth lap began Jarrott led by a minute, and at the fifth lap Gabriel was one minute ahead. But when the sixth and last lap came, a chain accident put Gabriel out of the race, and Jarrott shot ahead. Zbrowski and Mr. Vanderbilt, both Americans, finished creditably. The times of the chief contestants for the total distance of 512.41 kilometers are as follows: Jarrott, 5h. 53m. 39s.; Gabriel, 6h. 2m. 45s.; Vanderbilt, 6h. 22m. 11s.; Rigolly, 6h. 52m. 16s.; Zbrowski, 6h. 44m. 40s.; Girardot, 6h. 55m. 55s. After racing 512 kilometers Mr. Jarrott made a run of 100 kilometers to Sedan to get a bed.

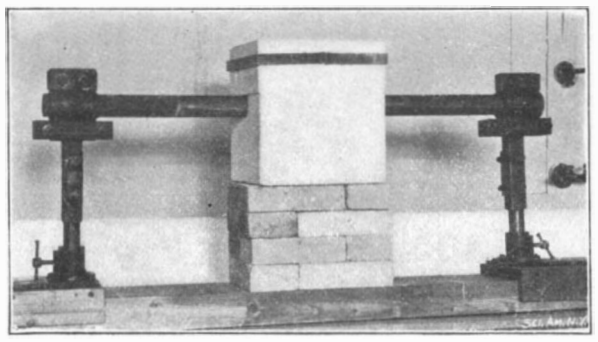
FORMATION OF THE DIAMOND BY THE ELECTRIC FURNACE.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Among the important discoveries made by M. Moissan with the electric furnace, none is more striking than the artificial production of the diamond. While the specimens he obtained were of almost microscopic size, it is none the less true that crystallized carbon has been obtained, and it is the object of the present article to show some of the steps in the process and the results which were finally reached. Before commencing the work M. Moissan made a series of researches upon the different forms of carbon, both those which occur in nature and the different varieties of graphite formed by the electric furnace. From these studies he became convinced that if the diamond could be reproduced, the first crystals obtained would be of microscopic size.

It may be considered that the diamond of nature has been formed in the midst of a liquid or pasty mass, and the natural question is, what solvent has been used for the carbon. M. Moissan found that iron in fusion is the best solvent for carbon, and he was led to search for the crystallization of carbon in melted iron under high pressure. A meteoric iron from the Diablo Cañon, Arizona, shows in the midst of the metallic mass two small transparent diamonds. Here nature seems to have been taken in the act. The iron containing the carbon must have been at first in the liquid state, and owing to a sudden cooling there occurred a violent contraction of the mass, and the carbon passed from a density of 2.0 to that of 3.5, giving the diamond. From these considerations M. Moissan was led to the experiments in which he succeeded in producing microscopic crystals of carbon which gave all the characteristics of the diamond.

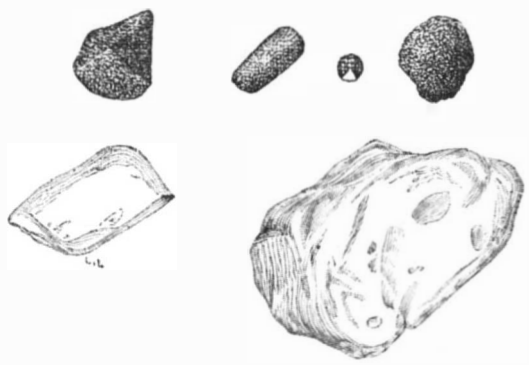
To carry this out he utilized the pressure produced by the increase in volume of a mass of iron when passing from the liquid to the solid state. Solid iron, as is well known, has a less density than the melted metal; pig iron, for instance, floats on a bath of melted iron. Like water, iron increases in volume at the moment of solidifying. The iron is now to be saturated with carbon at a high temperature and then suddenly cooled at the surface. The interior, while still liquid, is thus subjected to a high pressure. The iron must be saturated with carbon at a high temperature, and for this the electric furnace is used; the iron then dissolves a great quantity of carbon which it afterward abandons in the form of graphite or crystallized carbon. The electric furnace is of the type shown in the engravings. A block of chalk or quicklime, having a cover of the same material, contains a central cavity for the carbon crucible. The carbons are moved back and forth on their sliding supports and the arc is formed just over the crucible. In the first experiment 15 ounces of soft Swedish iron were placed in the crucible and covered with sugar-charcoal. The crucible is then heated under the arc with a current of 350 amperes at 600 volts; the cover of the furnace is removed and the crucible taken out and plunged into cold water. When cold, the metallic mass is attacked by hydrochloric acid to dissolve all the iron, and there remain three kinds of carbon; graphite, a brown-colored carbon (such as was observed in the Diablo Cañon specimen) and lastly a very small quantity of a denser carbon. All the carbon except the latter was dissolved out by a series of reactions, and the portions of very high density were separated by placing in bromoform. This liquid has a density as high as 2.9, and only the heavy particles fell to the bottom, consisting of black and transparent diamonds. By using a still denser liquid, the iodide of methylene, which has a density of 3.4, the black diamonds were made to float, and only the transparent crystals fell to the bottom. The former were first examined; under the microscope they have a gray-black appearance and their density is above 3. Some of them have well-defined angles and approach the cubical form. They will easily scratch the polished surface of a ruby. It only remained to burn them in oxygen, and this was done by placing them on a support inside a platinum tube through which a current of oxygen was passed; the tube was heated to 1,200 deg. C. by a blowpipe flame. The black diamonds were found to burn easily in oxygen, giving carbonic acid gas and leaving a trace of residue. The transparent fragments were, of course, the most interesting. They had the characteristic brilliant appearance and oily luster of the unpolished diamond. Their surface showed a number of parallel striæ. Some of them were round and others appeared as broken fragments; others, again, were cubical or of irregular form. The density of all these specimens was about 3.5 (seeing that they sank in the iodide of methylene). They scratched the ruby very deeply and could be burned in oxygen with scarcely a trace of ash. The yield of crystallized carbon is very small by this method, and a long series of reactions must be made in order to obtain a minute



MOISSAN DIAMOND-MAKING FURNACE.

quantity of the crystals. A second method was employed, using a small cylinder of soft iron which is bored out and closed by a screw stopper. The cavity formed is nearly filled with sugar carbon, which is strongly compressed by the screw. A quantity of soft iron is melted in the crucible and the cylinder is quickly plunged in the liquid bath. The crucible is then taken out and plunged into a bucket of water. In the meantime the cylinder has melted and the center of the mass is saturated with carbon. By the sudden cooling, a layer of solid iron is formed on the surface of the mass, and when this crust is at low redness the whole is taken out and cooled in the air. On breaking the mass a portion rich in carbon is found at the center in which are minute diamonds, both black and transparent. One of the clear specimens measures nearly 0.02 inch and answers to all the tests for the diamond. Another specimen was very pure and well crystallized.

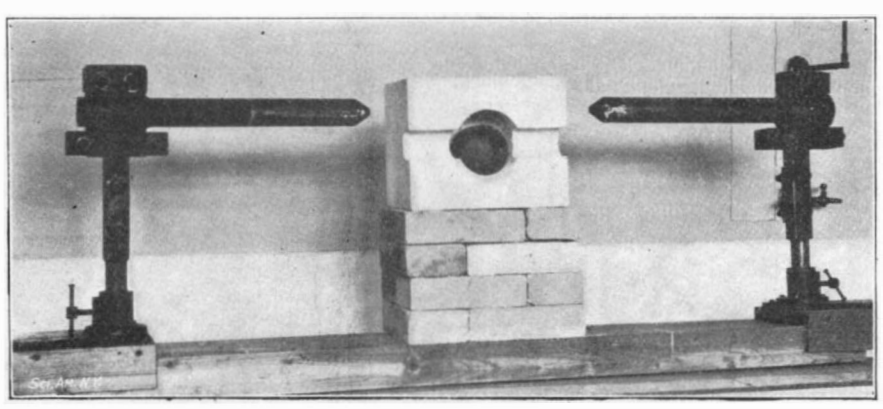
It was found that by the water-cooling method the



DIAMONDS MADE BY THE ELECTRIC FURNACE.

mass is surrounded by a layer of water vapor, and the cooling takes place rather by radiation across the vapor than by conduction, and is thus not rapid enough. To cool the mass more quickly and give a more sudden compression a bath of melted metal, preferably lead, was employed, and the resulting diamonds were found to be of better quality. In this case the crucible containing the iron, melted and saturated with carbon at 3,000 deg. C., is quickly plunged to the bottom of a bath of melted lead. The mass, which was at first pasty, becomes liquid on cooling and sends to the surface of the lead bath a number of small globules of iron, like shot. These globules contain the diamonds, which are separated as before. The striking point about this method is the brilliancy of the specimens which are obtained. One of the transparent diamonds whose diameter reached 0.02 inch, presented a triangular form with rounded angles. A curious fact is to be remarked in the case of this specimen; after three months it split into several fragments, and a second specimen became almost reduced to powder. This phenomenon is identical with that which occurs with some of the Cape diamonds, and it may be attributed to the unstable equilibrium of the mass which has been formed at a high pressure. Some of the specimens from the latter process are smooth and brilliant, while others have a shagreen surface; widely varying forms are obtained, from those which appear to be an assemblage of crystalline masses to specimens looking like a drop which has been suddenly solidified. The shagreen surface of the latter is identical with that of certain Brazil diamonds.

An interesting experiment was that of letting the melted iron fall through a hole in the bottom of the electric furnace in the form of globules or shot. One of the carbons is hollow, and through it an iron rod can be slid into the arc (Fig. 2). The melted globules drop into a vessel of mercury placed underneath the furnace. The spheres thus obtained gave black and transparent diamonds; the latter were small, but remarkably regular in form. Some of them were octahedra, measuring less than 1-1000 inch in their greatest length. One of the best methods is that of cooling the mass by direct contact with solid metal. A block of copper has a cylindrical hole bored in it in which fits a stopper of the same metal. The iron saturated with carbon is run into the block and the hole quickly corked; in this way the cooling is very rapid. When cold the copper and the outer iron are turned off in a lathe and the diamonds are found in the interior. This method gave a better yield and the specimens were fine and transparent.



MOISSAN ELECTRIC FURNACE, OPEN AND UPTURNED.

Increased Use of Oil Fuel.

BY E. P. WATSON.

The discovery of new sources for the supply of fuel oil has reawakened the possibility of using it in Atlantic liners and other high speed vessels. The objections hitherto have been uncertainty as to the continuance of the present oil fields, the slight margin of saving in comparison with coal in many localities, and want of success in obtaining good results through inexperience in the management of oil fuel, but these disappear, in great part, with the apparently unlimited production of the Texas and other new oil wells, and new types or systems of burners which are an improvement upon their predecessors. Many of the naval powers are now fitting out war vessels to use oil fuel, and others are experimenting with a view to its adoption later on. The German Admiralty have used oil on their China station for auxiliary purposes for months in lieu of coal. The Hamburg-American Company has four ships using liquid fuel wholly, and the North German Lloyd two, while the Dutch mail and cargo boats in the Far East employ oil solely as fuel. There are over thirty depots, or stations now where oil can be procured regularly by vessels, and more are being laid down as rapidly as possible.

Oil fit for fuel purposes has the following chemical composition: Carbon, 88 per cent; hydrogen, 10.75 per cent; oxygen, 1.25 per cent. The two other impurities present in the mass are water and sulphur. The action of water is obvious, while the sulphur if free, not in chemical combination, attacks both iron and steel, and mechanical means to separate the water, if oil is used on ship-board, are necessary. Recent experiments show that two tons of oil are equivalent to three tons of coal, while by volume 36 cubic feet of oil are equal to sixty seven cubic feet of coal as ordinarily stowed in bunkers. This increases the radius of action of a war vessel 50 per cent upon the bunker weight allotted and nearly 90 per cent upon the bunker space, without any alteration of the ship. It is also urged in favor of oil that it is easily supplied in mid-ocean—from transports—while coal presents great difficulties under the same conditions. In commercial work the gains predicted for oil vs. coal are surprising. In high-speed ships the weight and space occupied by the propelling machinery leave no room of any account for freight. The change from coal to oil would add nearly two thousand tons to the carrying capacity of a given ship, while, as oil fires never have to be cleaned, the speed would be constantly maintained. With these and many other advantages in favor of liquid fuel it is not unreasonable to look for its general adoption in the near future, both on land and sea. Many locomotives are now using it, and others are being built for oil service, both in this country and abroad.

Announcement is made that the United States War Department has arranged with Ehrhardt, of Düsseldorf, to re-arm the United States field artillery with Ehrhardt's new piece. The gun which the United States has acquired the right to use is said to be an improvement on the models supplied to Great Britain, of lighter weight and of longer range.

© 1902 SCIENTIFIC AMERICAN, INC.

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

CALF-WEANER. — LEWIS H. SAUNDERS, Colby, Kans. In order to prevent a calf or colt from sucking, the inventor employs a device comprising an inner frame of flat cheek-pieces, and an arched nose-yoke. The cheek-pieces are spread apart at their rear ends. To the inner, arched frame an outer, arched barbed frame is pivoted, to the rear ends of which a jaw-strap is secured which passes around the lower jaw of the animal. Should the calf attempt to suck or push the barbs up or down, the outer frame will force the jaw-strap against the lower jaw and hold the jaw shut.

CORN-HUSKER.—ARTHUR W. RICHARDS, Indianola, Iowa. The invention is a corn-husker which is adapted to operate upon the ears of corn after they have been cut from the stalk. The novel features are to be found in two series of rollers provided with pointed teeth. Both series extend in downwardly inclined parallel planes and are simultaneously rotated. The husks adhering to the corn ears are pierced by the teeth, shredded and stripped.

DERRICK.—ALVIN HODGSON, South Ottumwa, Iowa. Mr. Hodgson has devised a simple derrick which will doubtless be found of considerable usefulness on a farm for lifting and moving heavy weights, such as hay racks, wagon bodies, slaughtered animals, and the like. On a base comprising bottom rails, standards are erected, on which a table is supported. A post has a step bearing in the rails; and a plate secured to the post has a bearing in an opening in the table. The beam is mounted to swing on the post; and the winding-drum is carried by the post. Rope connections are provided between the drum and the end of the beam.

CULTIVATOR.—FRANK G. HOAG, Battle Creek, Mich. The inventor has devised a simple, compact, and strong machine which embodies means for the removal and replacement of a central toothed section; which also allows for the lateral adjustment of the toothed side frames, so as to cultivate both sides of a row of growing corn; and which allows the front portions of the side frames to be raised and to swing free.

Apparatus for Special Purposes.

STORAGE SYSTEM.—J. R. RECTOR, Lipan, Texas. In this invention Mr. Rector provides a house for storing perishable goods in which the goods will be kept cool without the necessity of ice or other analogous means of lowering the temperature, the temperature of the house being kept at a sufficiently low degree by a peculiar arrangement of air-circulating passages.

Engineering Improvements.

MARINE-ENGINE GOVERNOR.—MARTIN F. VOLKMANN, Santa Monica, Cal. Mr. Volkmann has provided a simple mechanism which is intended to prevent dangerous racing should the shaft break, the propeller be loosened, or lifted out of the water by the pitching of the vessel. The principle of the invention consists in speeding the governor upon the rise of the propeller from the water.

ENGINE-STOP.—HENRY JONES, Watertown, N. Y. This new engine-stop is arranged immediately and automatically to stop the engine in case of an accident. The arrangement is such that the engine can be shut down or started without interfering with the stop in any way. The stop comprises a cylinder to which a steam pipe leads. A piston reciprocates in the cylinder. Between the piston and the throttle valve is a flexible connection. The valve in the steam-pipe is opened from a governor when its stem drops.

VALVE-LUBRICATOR.—PETER F. LABAN, Altona-on-the-Elbe, Germany. The lubricating liquid is distributed by the movement or action of the valve to different portions of the valve-seat and between the ports in the chest. The valve is so constructed that it will always occupy an operative relation to the point of liquid-feed, so as to be supplied from the latter, notwithstanding the travel or movement of the valve. The lubricant is distributed through the valve-chest by open or exposed ducts or channels, so that it can be taken up by the steam and carried to all parts that require lubrication.

Mechanical Devices.

VELOCIPEDE DRIVING-GEAR.—FRANCIS A. RICH, Karangahake, Auckland, New Zealand. This changeable speed-gear for bicycles comprises an ordinary friction-clutch free-wheel sprocket, and a sprocket consisting of inner and outer members, normally loose relatively to each other. A driven mechanism can be shifted into operative engagement with the free-wheel sprocket, or with the outer member. A rocking clutch connects or disconnects the inner and outer members. A friction-roller on the rocking clutch is engaged by the guide of a rocking plate for the purpose of shifting the clutch.

PORTABLE REVOLVING THEATER. — CHARLES F. BRAMHALL, Kingman, Kans. In this portable revolving theater, there are embodied a central stationary stage and a circular revoluble auditorium. The audience is slowly carried around the stage so as to obtain a full view of all the proceedings. An improved curtain is provided which can be easily and quickly operated.

WASHING-MACHINE.—LAURA B. PARKER, 2874 Washington Street, Ogden, Utah. The machine is of that type in which a concave bed is employed within an outer casing, upon which the convex "rubber" rocks. The present invention is designed to supply this oscillating rubber with an elastic pressure in a more simple manner than heretofore. To that end a spring attachment of peculiar construction is resorted to, which is capable of being applied to all washing-machines of the type mentioned.

GRIPPER FOR PLATEN PRINTING-PRESSES.—ARTHUR L. ANDERSON, Grundy Center, Iowa. Mr. Anderson has devised a simple gripper which will firmly hold the paper to be printed on where a narrow margin is desired. His device can be so adjusted that its inner edge will be close to the desired outside line of the printing, thereby avoiding the annoyance so often experienced when it is desired to print upon an article so as to leave a very narrow margin. Ordinarily the gripper cannot be placed so as to hold the paper by reason of the gage-pin's coming in contact with the gripper. That difficulty is now obviated.

MEANS FOR AUTOMATICALLY CLOSING SWINGING DOORS.—EDWARD F. HUARD, Springfield, Mo. The invention is a closure for ice-houses or vaults. Its object is to provide a self-closing door which guards the opening through which blocks of ice are introduced to the house or vault, preventing an improper rise in the temperature, and the accumulation of fog in the air-space of the house.

HIGH-BALL ARCHER.—WILLIAM H. PEASE, Joliet, Ill. Mr. Pease has invented a simple and ingenious device for throwing a projectile by the power of a rubber band or the like. The invention comprises a body and an elastic structure which can be releasably held. The operating devices for actuating the structure comprise a trigger-arm, a connection between the trigger-arm and the holding means, a trigger working with the trigger-arm, and a spring actuating the parts normally to release the holding means.

LIFTING-GATE.—ANDERSON MILLER, Shelbyville, Ind. Mr. Miller is the inventor of a gate which embodies much that is new in its construction and operation. Mechanically considered, the gate consists of a post to which a frame is hinged, free to move vertically. The frame comprises top, bottom and side members. A rod connects the top and bottom members and serves as a brace. Upon the rod is a lever. Angle-braces are secured to the top and bottom members at points adjacent to the ends of the rod, and engaging one of the side members at a point between the ends. A cord engages the lever and post and partially encircles the pulley, The handle of the lever being depressed, the cord is pulled, thereby raising the gate.

SNOW-PLOW.—PETER W. MARTIN, Thumb Lake, Mich. The snow-plow can be quickly and easily adjusted to discharge snow at both sides, or to discharge snow at either side. The horses propelling the plow are placed at the back, so that they are not compelled to walk in deep snow, as would be the case were they harnessed at the front.

POTATO-CREAMER.—FREDERICK W. RUCKSTUHL, and ADELE POHLMANN, Manhattan, New York city. This device is arranged to reduce boiled potatoes or the like to a creamy consistency in the smallest possible amount of time. The device is very simple and durable in construction, can be cheaply manufactured and easily manipulated.

GAGE AND BUTT-CUTTER FOR CIGARS.—WILLIAM HEFFLEY, Jackson Township, Lebanon county, Pa. The invention relates to means for gaging the length and clipping the butts of cigars as they are being manufactured. The inventor has devised an apparatus of this character which is of simple construction, compact form, and very convenient in operation, producing a portable implement that can be set to cut off the butts of cigars at a desired length as a finishing operation in their manufacture.

Miscellaneous Inventions.

BANJO ATTACHMENT.—H. M. BRONSON, Brandon, Vt. Mr. Bronson provides an improved attachment for banjos and like instruments which may be conveniently employed and will act to remove all harshness from the tone, rendering the music produced soft and sweet.

UMBRELLA-STICK.—T. H. SMITH, Lansford, Pa. The invention provides an umbrella which may be compactly folded and quickly and conveniently brought into a position for use. The construction is simple and durable, and is so arranged that the strength of the umbrella will not be lessened, also that the umbrella may be readily manipulated by any person of ordinary intelligence.

GEM-SETTING.—R. S. BIEBER, Brooklyn, N. Y. The usual method of setting stones of diamond shape is to fasten the stone by bending small fingers over its edge. This invention is designed to make a more secure setting for the gems by employing a band which encircles the edges of the gem and is held in place by the fingers of the setting.

RANGE-FINDER ATTACHMENT FOR GUNS.—A. P. COLLINS, Manilla, P. I. Sergt. Collins finds from practical experience that it is difficult for the average soldier to gage a distance of between 400 and 2,000 yards with sufficient accuracy to make his fire effective. He has, therefore, devised a simple attachment for use in connection with ordinary firearms which will enable a soldier to determine the range of the object to be fired at, and the corresponding adjustment required to be given to the elevating sight.

FOLDING BASKET. — T. J. LANGSTON, Johnston, S. C. Mr. Langston has invented an improved form of basket of that class which have a collapsible body portion and a folding handle frame. The handles are pivoted directly to the body of the basket. The lower ends of the handles are connected with the bottom of the basket and are extended to form legs.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 3066.—For manufacturers of ice-making machinery.

AUTOS.—Duryea Power Co., Reading, Pa.

Inquiry No. 3067.—For manufacturers of office specialties, household novelties and articles suitable for mail order business.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 3068.—For manufacturers of automobile castings.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 3069.—For dealers in dummies used in ventriloquism.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 3070.—For rope-making machinery.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 3071.—For manufacturers of small engines and boilers.

Die work, experimental work and novelties manufactured. American Hardware Mfg. Co., Ottawa, Ill.

Inquiry No. 3072.—For manufacturers of paper novelties.

Our specialty is cutting and forming metal parts any shape. Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 3073.—For manufacturers of small engines, two to three inch stroke and same size cylinders. Oscillating engine preferred.

Gear Cutting of every description accurately done. The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 3074.—For manufacturers or dealers in game markers or counters.

We design and build special and automatic machinery for all purposes. The Amstutz-Osborn Company, Cleveland, Ohio.

Inquiry No. 3075.—For manufacturers of car-building machinery.

IDEAS DEVELOPED.—Designing, draughting machine work for inventors and others. Charles E. Hadley, 584 Hudson Street, New York.

Inquiry No. 3076.—For manufacturers of rubber penholders.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 3077.—For manufacturers of absorbent pulp plates.

Patents developed and manufactured, dies, special tools, metal stamping and screw machine work. Metal Novelty Works Co., 43-47 S. Canal St., Chicago.

Inquiry No. 3078.—For manufacturers of tubs.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 3079.—For manufacturers of cork packing.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers. 361 Broadway, N. Y.

Inquiry No. 3080.—For wood-carving machinery.

WANTED.—A bright, active young man as assistant superintendent for a large machine shop, to take charge of all tools. Must be a hustler and familiar with modern practice as to cutting speeds, etc. State salary and experience. H. F. W. Box 773, New York.

Inquiry No. 3081.—For manufacturers of small water motors.

FOREMAN BOILER MAKER WANTED.—First class man wanted for a modern shop building marine and stationary boilers, and doing boiler and iron ship repairs. Applicants will please state age, experience, nationality, and give names of previous employers. This is a good position for a good man. Address P. O. Box, 2685, Boston.

Inquiry No. 3082.—For machinery for making nails and bolts.

☞ Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway, New York. Free on application.

Inquiry No. 3083.—For a spring motor suitable for running a sewing machine.

Inquiry No. 3084.—For manufacturers of sheet aluminium.

Inquiry No. 3085.—For rough castings for gas or gasoline engines, also dynamos and motors.

Inquiry No. 3086.—For manufacturers of a telephone system for private use operated without a switchboard.

Inquiry No. 3087.—For manufacturers of the C. H. Webb adding machine.

Inquiry No. 3088.—For manufacturers or dealers in glass cloth.

Inquiry No. 3089.—For the address of the Libby Glass Works.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

August 19, 1902,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Acid and making same, methylene di-aceto di-salicylic, S. L. Summers 707,178
Acid ester of methylene diguaiacol and making same, camphoric, S. L. Summers 707,278
Adding machine, Ellis & Perkins 707,309
Adjustable furnace, R. Halley 707,104
Advertising device, W. D. Butt 707,205
Air from sand-blast apparatus, apparatus for cleaning, J. E. Mathewson 707,134
Air heating apparatus, compressed, G. W. Hopkins 707,111
Albuminous substances, obtaining, A. Jolles 707,423
Amalgamator, G. H. Breymann 707,296
Atropinium alkyl nitrate, Dreser & Callsen. 707,402
Auger, packing, E. E. Ziegenfuss 707,290
Autographic register, J. C. Shoup 707,458
Automobile, J. C. Henry 707,230
Automobile running gear, A. A. Medina 707,340
Automobile steering gear, J. G. MacPherson 707,435
Automobiles, transmission gear for, G. P. Dorris 707,400
Balls, manufacture of playing, E. Kempshall 707,425
Band cutter and feeder, W. N. Crow 707,393
Bar. See Type bar.
Bark from trees, apparatus for removing, W. P. Kidder 707,428
Beam machine, reciprocating, N. H. Seeley. 707,168
Bearing, M. Steiner 707,176
Bearing for lawn mowers, ball, A. B. Case. 707,298
Bearings for shafts of machines, N. H. Seelye 707,167
Bearing, roller, J. D. Twiggs, Jr. 707,463
Belt, conveying, J. J. Ridgway 707,355
Bevel and miter, combined, C. R. Stedman. 707,461
Bicycle, W. N. Whitely 707,480
Bicycle gear, changeable, P. J. Scharbach .. 707,359
Bicycle lock, J. C. Fisher 707,310
Bicycle toe clip, G. W. Cole 707,209
Bicycles, device for coupling two, J. Kynaston 707,122
Bicycles or like vehicles, cushion frame for, Sager & Green 707,262
Binder needle, E. Will 707,482
Boards by means of cleats, machine for securing together, C. Johnson 707,116
Boats, etc., apparatus for removing material from, A. M. Acklin 707,371, 707,491, 707,492
Boiler, A. W. Ofeldt 707,519
Boiler and its furnace, S. A. Graham 707,509
Boiler furnace, steam, J. R. Bailey .707,495, 707,496
Boiler or water heater, D. M. & A. B. Burns 707,203
Boot or shoe welt, J. O. Bicknell 707,076
Bottle, non-refillable, E. I. Allen 707,068
Bottle, non-refillable, S. D. Blocker 707,199
Bottle, non-refillable, T. E. Shortell 707,265
Bottle, non-refillable, E. Hoerichs 707,512
Bottle stopper, J. J. Allison 707,193
Bottle stopper, A. C. Packer 707,348
Bowls or basins, clamp for marble wash, W. McClintock 707,153
Box fastener, W. Jordan 707,424
Braids and trimmings, machine for making, J. E. Kirberg 707,336
Brake, A. R. Moore 707,149
Brake beam, B. Haskell 707,105
Brake, fender, and step, combination, D. Neale 707,345
Brick machine, W. F. Stimpson 707,275, 707,276
Brooder, O. R. Lincoln 707,127
Broom handles, polishing and drying, C. A. Ridlon 707,159
Buckle, back band, E. H. Crum 707,394
Building material, box of, O. Nentwig 707,446
Burglar alarm, J. H. Howard 707,513
Burner, M. S. Walker 707,285, 707,286
Button, G. W. Buchanan (reissue) 12,020
Button and making same, M. D. Shipman .. 707,456
Button feeding mechanism, J. Hormby 707,329
Button making machines, grip carrier for, J. Hormby 707,326
Button making machines, segmental gear for, J. Hormby 707,328
Button making machines, spindle adjustment for, J. Hormby 707,330
Button setting machine, E. E. Stimpson ... 707,274
Cable support, J. E. Gamalielson 707,314
Cable track roads, support for suspended, H. M. Harding 707,228
Camera, magazine, Perks & Fletcher 707,156
Camera, photographic, H. W. Hales 707,319
Camphene, making, K. Stephan 707,270, 707,271
Can opener, J. Chisholm 707,207
Can opener, J. W. Pierce 707,253
Cane stripper, sugar, T. A. Dutton 707,091
Canopy, F. C. Winants 707,483
Car brake, W. House 707,231
Car coupling, P. Hien 707,108
Car coupling, automatic, J. M. Stanley 707,269
Car door mechanism, E. J. Muller 707,342
Car door operating device, J. Simonton ... 707,459
Car haul, S. W. Bollinger 707,200
Car heating apparatus, railway, J. Q. C. Searle 707,361
Car, metallic railway, Hornbrook & Woodcock 707,416
Car, railway, G. W. Chipley 707,302
Car wheel, G. Killian 707,120
Carbureter, E. Walther 707,467
Carpenter's tool, M. F. Doyle 707,307
Carriages, feed pump and connection for horseless, J. C. Blevney 707,079
Cart, ash, W. Schaller 707,163
Cash register, F. B. Barnard 707,195
Cash register, F. H. Bickford 707,380
Cash register, G. S. Green 707,408
Casks, barrels, or like vessels, apparatus for lining, H. S. Russell 707,260
Centrifugal machine, H. de Raasloff 707,521
Checkreins, elastic connection for, J. M. Chaffin 707,388
Cheese marker, J. Wolfinger 707,528
Chute for loading wheat or flour on ships, F. W. Brink 707,297
Clip. See Bicycle toe clip.
Clutch, tug sheave, H. B. Harding 707,321
Coal bagger, H. B. Sackett 707,358
Cock, hydrant, J. H. Kidder 707,119
Coke, manufacturing, J. W. Seaver 707,525
Coke quenching or cooling apparatus, L. Bertrand 707,379
Compartment box for checks or the like, J. T. Hicks 707,325
Compress, M. M. Kerr 707,426
Condensing apparatus, atmospheric steam, F. R. Brandt 707,081
Cooking utensil, steam, G. F. Edminston ... 707,217
Cord holding device, F. H. Knapp 707,241
Corn pad, I. Duckworth 707,089
Corn shock loader for vehicles, W. A. Tea .. 707,280
Cotton gin, J. T. Fuller 707,096
Cuff holder, W. C. Kewin 707,427
Curb and gutter block, combined, J. R. Jecklin 707,115
Current motor, synchronous alternating, A. Churchward 707,389, 707,390
Damper attachment, stove, J. R. Stover 707,366
Deodorizing, F. M. Pratt 707,354
Detonating compound, U. Alvisi 707,493
Dish washing apparatus, J. D. Morley 707,443
Distribution system, J. F. Kelly 707,334
Door hanger, P. H. Luitink 707,131
Draft attachment, C. H. Falk 707,092
Draft rigging, W. E. Coffin 707,501
Drawing board and appliances, Schlachter & Allen 707,165
Dredge, hydraulic, L. W. Bates 707,293

(Continued on page 148)

© 1902 SCIENTIFIC AMERICAN, INC.

Drilling machine, F. N. Gardner 707,507
Dye and making same, anthracene, O. Bally 707,373, 707,374
Electric motor controller, W. H. Chapman 707,300
Electric roller for massage and therapeutical purposes, J. W. Gibbs 707,508
Electrical distribution system, W. S. Moody 707,150
Electrical switch, L. L. Elden..... 707,505
Electrochemical generator, H. S. Amwake. 707,372
Elevator safety device, J. W. Fleming.... 707,311
Elevator safety stop, W. Fehler 707,407
Elevator signal, electric, L. K. Curlett... 707,305
Elevators, brake for motor shafts of, E. W. Moon 707,442
Elevators or the like, safety suspending apparatus for, R. Hainsworth..... 707,410
Embroidery frame and holder, J. H. Post.. 707,353
Emergency brake, C. Vogel..... 707,465
Emery wheels, apparatus for wetting, E. R. Hyde 707,420
Enamel sifting apparatus, C. H. Zwermann. 707,490
Envelop, L. A. Bennett..... 707,074
Envelop, C. A. Dunn 707,308
Fastener, J. E. Traver 707,369
Fastener, W. B. H. Dowse..... 707,504
Felies or the like, attachment for cutting, W. E. Swindell 707,179
Fence, wire, M. D. Shipman 707,457
Fencing, wire, M. D. Shipman..... 707,455
Fibrous materials, machine for circulating and separating waste, J. Marshall.... 707,133
Fifth wheel, J. Watts 707,189
Filter, C. Hungerford 707,333
Filter press, F. M. Locke..... 707,245
Fire escape, D. Neale..... 707,346
Fireproof building, F. W. Cooley...707,086, 707,210
Fireproof ceiling and floor, S. G. Brinkman 707,201
Fluid pressure brake, H. H. Westinghouse 707,473, 707,474
Folding box, A. W. Beers..... 707,073
Folding table, G. E. Shorey..... 707,171
Food, cattle, G. H. Hughes..... 707,113
Foundations, building subaqueous, J. T. Ford 707,093
Frame. See Embroidery frame.
Friction brake, H. A. House, Jr..... 707,232
Fruit stemmer, J. A. North..... 707,154
Fuel feeding apparatus, W. G. Stones (reissue) 12,023
Fuel, manufacturing artificial, E. J. Hoffman 707,231
Furnace, R. Halley..... 707,103
Furnace, J. Reagan 707,157, 707,158
Furnaces, apparatus for increasing combustion in, J. H. McConnell 707,249
Furniture, folding, W. Wenneis 707,288
Galvanic battery, E. L. Slocum..... 707,263
Galvanizing machine, R. Heathfield..... 707,322
Game, W. M. Wayts 707,469
Game apparatus, S. A. Akins..... 707,291
Garment supporter, B. L. Bargar..... 707,070
Gas and steam convertible engine, G. Dahlberg, et al (reisue)..... 12,021
Gas generator, acetylene, D. W. Bishop, 707,077, 707,078
Gas or other pipes, pressure reducer for, Geyer & Prime 707,318
Gas producer, L. L. Merrifield..... 707,146
Gate, H. P. Egedal 707,218
Gate, A. M. Lance..... 707,431
Glazed structure, J. H. Steffey..... 707,175
Glove, J. C. Allen 707,069
Gluing machine, W. F. Epperson..... 707,219
Glycolic menthyl ester, Hofmann & Callsen 707,110
Golf ball, A. T. Saunders 707,263
Grain, etc., apparatus for drying, cooling, or otherwise treating, G. H. Hess, Jr.. 707,323
Grain separator, C. Otto..... 707,251
Grave filler, U. H. Deering..... 707,503
Gun carriage, O. Behnke..... 707,376
Gun carriage, Dawson & Buckham.707,398, 707,399
Gun carriages, combined axle seat and shield for, Lauber & Stock..... 707,432
Hame fastener, E. G. Bennett..... 707,497
Hammer, pneumatic, C. K. Pickles..... 707,350
Hammer, pneumatic, H. J. Kimman..... 707,515
Hammer, pneumatic power, H. F. Massey. 707,246
Handle bar support, L. S. Kallajian..... 707,514
Hanger. See Door hanger.
Harvester, beet, W. Gary..... 707,097
Harvesting machines, finger bar for, J. F. Steward 707,460
Hat brims, machine for trimming curled, F. C. Craw 707,392
Hat, ventilated, J. Wolbrecht 707,486
Heating apparatus, I. D. Smead..... 707,364
Heating boiler, sectional, E. O. Haskins.. 707,229
Heel nailing machine, B. F. Mayo..... 707,144
Heel nailing machines, means for detaining or releasing top lifts in, E. A. Lougee. 707,143
Hoisting bucket mechanism, A. Wirsing.... 707,484
Holder, H. P. Jones 707,234
Hominy, meal and grits drier, W. L. Burner 707,384
Horse protector, R. M. Sebree..... 707,166
Horseshoe, F. Sheeley 707,454
Horseshoes, ice-sandal for flat, I. G. Howell 707,417
Hot air furnace, T. J. March 707,437
Hydrocarbon vapor burning apparatus, A. B. Macklin 707,517
Ice, etc., apparatus for elevating or conveying and transferring, E. A. Wright, 707,487 to 707,489
Image projecting apparatus, C. W. Carmen 707,084
Ingot mold, J. E. Sweet 707,279
Inhaler, J. H. McCulloch..... 707,445
Insulating joint for pipes, Cleland & Murray 707,303
Insulator for electric wires, T. F. King.... 707,429
Joints for intersecting wires or rods, forming, J. C. & W. J. Pope..... 707,352
Journal bearing, I. Metzger 707,147
Keyhole guard, F. H. Bos 707,381
Knob attachment, W. S. Bartholomew.... 707,375
Lace, electrodepositing metal on, J. A. Daly 707,306
Lace machine, C. Martin 707,436
Lacing hook, W. A. Dunham..... 707,090
Ladders or the like, antislipping foot for, A. Kern 707,238
Lamp, carbureting, G. Wedderburn..... 707,190
Lamp, electric arc, C. L. Bundy..... 707,383
Lamp, hydrocarbon, G. R. Stillman..... 707,177
Lamp, incandescent electric, E. S. Gardiner 707,099
Lamp, incandescent gas, G. Tresenreuter.. 707,185
Lamp sockets, machine for molding incandescent, C. A. Chase 707,299
Lathe, J. L. Osgood 707,155
Leather skiving machine, J. W. Poole.... 707,351
Leer, Naysmith & Reese..... 707,343
Leg improver, H. A. Rhonemus 707,258
Leveling machine, J. J. Heys 707,414
Leveling rods, extension fitting for, G. S. Goodale 707,225
Liquid fuel burner, R. Halley..... 707,510
Liquid separator, centrifugal, W. W. Marsh 707,132
Loading or unloading device, lumber, W. Sauntry 707,162
Locomotive driving wheel, L. H. Kenyon.. 707,335
Locomotive pedestal, T. E. Collins 707,502
Loom stopping device, W. T. Lucie..... 707,130
Magnetic separator, A. Dings 707,088
Mail bag catcher, G. W. Smith..... 707,267
Mail bag receiving and delivering apparatus, A. P. Hauss 707,412
Mail receiving and delivering mechanism for railways, F. H. Burr 707,500
Match, C. M. Bowman 707,080
Match box, combination, C. St. Jacques... 707,277
Measuring the degree of exposure to light, instrument for, F. Schoeler..... 707,164
Mechanical movement for nut making or other machinery, Burdict & Candee.... 707,202
Medical electrode, G. G. Marshall..... 707,438
Metal dressing machine, Stiker & Burton.. 707,272
Metal dressing machines, slide for, Stiker & Burton 707,273
Milling machine feed mechanism, Fox & Lund 707,095
Mirror, adjustable, M. H. Moss..... 707,151
Mixing machine, E. Ruttkamp..... 707,261
Mixing machine, J. H. Elward..... 707,404
Mop wringer, J. von Kanel..... 707,235
Motion converting mechanism, J. Horrocks. 707,112
Mower, lawn, W. H. H. Heydrick..... 707,324
Mower, motor lawn, T. & W. H. Coldwell. 707,304
Musical instruments, operating sheet for automatic, E. S. Votey 707,283
Nail assorting apparatus, B. F. Mayo, 707,137, 707,139
Nail assorting apparatus, A. D. Elliott.... 707,140
Nail assorting machines, raceway for, B. F. Mayo 707,142
Nail assorting mechanism, B. F. Mayo.... 707,136
Nail assorting mechanism, Mayo & Elliott. 707,138
Nail assorting mechanism, C. C. Small.... 707,141
Nebulizer, C. Truax 707,282
Needle threader, O. A. Aicardi..... 707,191
Negatives, producing trichromatic half-tone process, F. E. Ives 707,421
Nut lock, W. Graham 707,102
Nut lock, J. P. Birmingham..... 707,499
Nut wrench, axle, R. A. Moody..... 707,248
Ordnance, device for the prevention of erosion in, H. Maxim 707,135
Ore breaker, A. C. Calkins 707,385
Ores, testing, J. Herman 707,107
Ores, treating mixed sulfid, E. Ferraris.. 707,506
Oven, rotary bake, F. H. Van Houten..... 707,187
Packing case or box, C. Thiebaut..... 707,183
Packing structure, cellular, H. H. Higham. 707,415
Pad. See corn pad.
Painting metal furniture, drip pan for, H. E. Crome 707,087
Paper cutting machine, C. D. Blackhall.... 707,294
Paper machine, wall, C. B. Weston..... 707,289
Pattern plate, C. R. Davis..... 707,397
Pegging machine, J. E. Bickford 707,498
Phonographs, etc., recorder for, H. V. Butterworth 707,204
Photographic attachment for optical instruments, F. E. Ives 707,422
Photographic developer, A. Eichengrun.... 707,403
Photographic developing apparatus, E. Rimailho 707,450
Picker stick strap, C. Faber 707,406
Pigments, making, J. Lones..... 707,434
Pitman coupling, J. R. Carter..... 707,386
Plane, A. W. Stanley..... 707,365
Plane, grooving, J. A. Traut..... 707,281
Plane iron cap, Traut & Walter..... 707,368
Plane lift, Riecker & Walter..... 707,356
Plane, recessing or grooving, F. Clayton.. 707,085
Plant protector, L. J. Merriman..... 707,247
Planter, R. Murphy..... 707,152
Plate handling machine, R. R. Spears..... 707,172
Pliers, M. M. Howland..... 707,418
Plow, potato, D. Jackson 707,114
Plug receptacle, C. J. Klein..... 707,516
Plumb bob, level, etc., combined, D. L. McDermott 707,518
Pneumatic tube systems, pneumatic time lock for, B. C. Batcheller 707,071
Pole attachment, carriage, P. Masterson. 707,439
Post office box indicating mechanism, T. F. Kelly 707,236
Postal box and signal, F. C. Bates..... 707,196
Powder bag, ordnance, C. T. Dorr 707,401
Precious metals, treating rebellious ores of the, W. F. Downs 707,214
Press. See Filter press.
Printing machinery, S. G. Goss 707,100
Printing press, S. G. Goss 707,101
Printing presses, adjustable and throw-off roller track for, A. W. Fritz 707,313
Propellers of ships, means for housing, J. Hamilton 707,411
Puller. See Weed puller.
Pulley mechanism, reversing, Darling & Ellenberger 707,396
Pump, hydraulic, W. Wagner 707,284
Rail fastener, C. M. Reed..... 707,257
Rail joint, D. H. Noble 707,447
Rail joint, O. S. Weddell 707,471
Railway, combined overhead and underground electric, D. S. Bergin..... 707,075
Railway joint, T. L. Watts 707,468
Railway rail joint, E. R. Avery..... 707,494
Railway signal, automatic, Emerson & Hovander 707,405
Railway signaling apparatus, J. D. Taylor. 707,182
Railway signaling apparatus, selector for, J. D. Taylor 707,180
Railway switching and signal interlocking apparatus, J. D. Taylor 707,181
Railway trains, electric block system for, J. T. Hambay 707,226
Razor, C. Freitag 707,223
Rheostat or heater, electric, H. P. Ball.. 707,194
Rheostats, electric heaters, etc., resistance for, H. W. Leonard 707,244
Ribbon and stock supporter, J. H. Whittington 707,479
Rice hulling machine, J. B. Cornwall..... 707,211
Rock cutting apparatus, F. Lobnitz..... 707,128
Rod reel, B. H. Gedge..... 707,317
Roof, ceiling, and floor construction, B. McDougall 707,250
Rotary engine, W. F. Stanley..... 707,174
Safe, burglar proof, D. Neale..... 707,344
Sand and producing same, artificial, J. A. Shinn 707,170
Sand blast apparatus, A. G. Warren..... 707,527
Sash weight, Beckwith & Lamphere..... 707,197
Sash, window, E. Heroux..... 707,106
Sawmill set works, J. Walton..... 707,370
Saw slabbing machine, twin, E. E. Thomas 707,184
Screw cap closure, H. J. S. Hall..... 707,320
Screw cutting die, C. J. Jackson..... 707,233
Scythe snath bending machine, G. M. Fenn 707,221
Seal, car, J. N. Brunner..... 707,083
Sealing machine, bottle, H. T. Gay..... 707,316
Sewing machine, chain stitch, H. J. Hancock 707,227
Sewing machine, lock stitch shoe, A. B. Fowler 707,094
Sewing machine take up, F. W. Merrick.. 707,145
Shade adjustment, F. H. Knapp 707,240
Shade holder, adjustable window, Hewes & Bittner 707,413
Shade support, E. A. Livet 707,433
Shaft coupling, R. W. Scott 707,453
Shaft coupling, power, O. Rudd 707,357
Sharpener, C. F. Brown..... 707,082
Sharpener, knife and pencil, L. Johnson... 707,118
Silo, Lacey & Fuller..... 707,123
Skirt protector, J. Cathrein..... 707,387
Skylight, E. J. Hulse 707,419
Smoke and spark preventing device, W. S. Hughes 707,332
Smoke consumer, L. E. Morgal 707,341
Smoking pipe, A. S. Speirs 707, 88
Snow plow, cylinder rotary, H. H. Kryger. 707,121
Solder for soldering aluminium, J. C. Webster 707,470
Soldering iron, J. C. Covert 707,212
Speeds are exceeded by vehicles, apparatus for indicating when certain predetermined, A. F. Poillevillain, (dit P. Villain) 707,254
Spinning apparatus, yarn, G. O. Draper... 707,215
Spinning or roving machine, W. V. Threlfall 707,462
Square, engineer's, W. Chesterman..... 707,301
Stacker, pneumatic, J. H. Elward (reissue). 12,022
Stamp affixer, E. A. Bienenstok 707,198
Stamp tappet, C. C. Rueger..... 707,259
Steam boiler, H. A. Duc, Jr..... 707,216
Steam boiler, water tube, A. Mehlhorn... 707,440
Steam trap, J. Bonar..... 707,295
Steering machinery, A. B. Brown..... 707,382
Stock tank, W. C. Wright..... 707,530
Stones, etc., apparatus for separating, J. C. W. Stanley 707,173
Stones or mortar, composition for making, J. Loewenthal 707,129
Stove, portable, E. C. Leonard..... 707,243
Stove, force draft attachment for, S. J. Walker 707,188
Strap. See Picker stick strap.
Street cleaning machine, J. Thery 707,367
Surveying and reconnaissance instrument, J. C. Sala 707,161
Swinging gate, Reames & Heffington..... 707,256
Switch stand, J. J. Schrag 707,360
Tablelock, pedestal extension, E. Tyden. 707,186
Tablet, manifolding, B. F. Hoard..... 707,511
Telegraph keys, automatic circuit closer for, J. E. Folsom 707,312
Telephone receiver, L. Mellett..... 707,441
Temple attaching device, F. G. Hirst.... 707,109
Tent, J. P. Nelson 707,347
Threshing machine attachment, J. G. Walker 707,287
Tie plate, C. S. Shallenberger..... 707,362
Tile, F. R. Lawrence 707,125
Tile setting or removing apparatus, H. Schmidt, Jr. 707,264
Tire for vehicle wheels, spring, H. C. Shearman 707,169
Tire, vehicle wheel, Belledin-Gras & de Mondran 707,378
Tool holder, S. Welter and J. Armstrong.. 707,472
Towing mechanism, canal, S. W. Wood.. 707,529
Toy boat, E. E. Mitchell 707,148
Toy pistol, C. F. Paulus..... 707,252
Tram protecting rollers, safety ball for, E. Raus 707,255
Trolley, P. E. Loree 707,338
Trolley lubricator, P. E. Loree 707,339
Trolley wires, automatic line catch for, G. R. Floyd 707,222
Trousers supporter, J. D. Aiken 707,192
Truck side and center bearing, car, E. Cliff 707,208
Tube expander, H. M. Barr 707,292
Type bar for matrix plates, master, J. R. Reynolds 707,523
Type chase for making matrix plates, J. R. Reynolds 707,522
Typewriting machine feeding attachment, M. S. Eylar 707,220
Typewriting machine ribbon fastener, F. O. Garrison 707,098
Umbrella, folding, A. and F. Schaefer..... 707,451
Umbrella runner, Kenney & Fogler 707,237
Valve, J. H. Koch 707,337
Valve, automatic, N. Curtis 707,395
Valve cushioning device, E. Rost..... 707,160
Valve, equalizing, P. Whiting..... 707,476
Valve mechanism for steam carriage burners, R. H. White 707,478
Valve motion, G. M. Schwend 707,452
Valve, quadruple, P. Whiting..... 707,477
Valve, safety, Wishart & Seidel..... 707,485
Vehicle body, motor, Charron & Girardot.. 707,206
Vehicle steering mechanism, locking device for, C. S. Van Wagoner 707,464
Vehicles, brake for pivotal running gear of, W. Wiedinmyer 707,481
Vending machine, coin actuated, F. M. Sears 707,524
Wagon body lifter, G. H. Wade..... 707,466
Wagon running gear, F. H. Pickard..... 707,520
Waist former, long, J. C. Kimsey..... 707,239
Wall and bricks for same, masonry, A. H. Moses 707,444
Washboiler, G. Leeson 707,126
Washing machine, T. H. C. Beall..... 707,072
Washing machine, J. M. Lawrence..... 707,242
Washing machine, O. Guitar..... 707,409
Watchcase, E. Kuhn 707,430
Water distribution, O'Neill & Gordon 707,448
Water heater, T. L. Phillips 707,349
Wave detecting device, Shoemaker & Pickard 707,266
Weed puller, J. A. Whelan 707,475
Weight motor and governor mechanism, W. D. Bell 707,377
Wheels and the product thereof, molding spoke, Dickerson & Gordon..... 707,213
Whips, butt loading for, H. W. Larsson. 707,124
Window screen, O. Ouellette..... 707,449
Wire machine, barb, Gauerman & Pryde.. 707,315
Wire stretcher, Shinn & Herbert..... 707,526
Wood, preserving, T. Giussani..... 707,224
Work carrier locking device, J. Hormby.. 707,327
Wrench. See Nut wrench.
Wrench, R. J. Cosseboom..... 707,391

DESIGNS.

Bed case, folding, C. L. Gamer..... 36,019
Box or carton, F. Goetz..... 36,016
Button hooks, paper cutters, or similar articles, handle for, T. W. Foster..... 36,010
Coffee or tea pot, H. Nutrizio..... 36,014
Curtain, lace, A. Burgess..... 36,020, 36,021
Mirrors, brushes, or similar articles, back for hand, L. C. Porter..... 36,012
Plate, souvenir, L. Wohltman..... 36,013
Ring, A. Becker..... 36,009
Toilet boxes, mirrors, or similar articles, back for, T. W. Foster..... 36,011
Type, font of lower case printing, Nadall & Barnes 36,017
Type, font of upper case printing, B. Nadall 36,018
Zither body, C. E. Brown 36,015

TRADE MARKS.

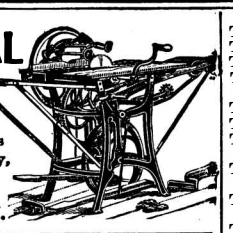
Ale, ginger, Standard Bottling & Extract Co. 38,810
Ammunition, certain named, Peters Cartridge Co. 38,801
Beer, Independent Brewing Association..... 38,809
Beer, lager, Independent Brewing Association 38,808
Boots and shoes, F. M. Fargo 38,793
Bread, C. F. Schupp & Son..... 38,816
Cocoa and cocoa preparations, Kakao-Compagnie Theodor Reichardt, Gesellschaft mit, Beschrankter Haftung..... 38,815
Coffee, Woolson Spice Co..... 38,814
Cotton thread, New England Cotton Yarn Co. 38,789, 38,790
Gas burners, G. Bray & Co. 38,826, 38,827
Gas burners, D. M. Steward 38,828
Hat cleansing compounds, Riverside Chemical Co. 38,796
Heels and soles, for boots and shoes, elastic or cushion, F. W. Whitcher & Co.... 38,791
Inks, writing, Carter's Ink Co. 38,797
Lamps, incandescent electric, National electric Lamp Co. 38,825
Leather, Beggs & Cobb 38,795
Medical compounds, certain named, G. R. White 38,799
Medical compounds, certain named, Farbwerke, vorm. Meister, Lucius & Bruning 38,800
Medicines, laxative, Prunetta Pharmacal Co 38,802
Mohair, alpaca, and luster wool linings, E. G. Williams & Co..... 38,788
Paper bags and wrapping paper, Eagle Paper Co. 38,818
Periodicals, Phelps Publishing Co. 38,817
Photographic goods, certain named, Century Camera Co. 38,819
Pumps, hydraulic air, Cleveland Faucet Co. 38,829
Razor strops, A. J. Jordan Cutlery Co.... 38,824
Razors, knives, scissors, and shears, A. L. Silberstein 38,823
Rheumatic cure, liquid, F. J. A. Wall .. 38,803
Salves, H. Welch 38,798
Shoes, children's, Watson Plummer Shoe Co. 38,792
Shoes, leather, Anglo-Saxon Shoe Co..... 38,794
Silks, dress, Liberty Silk Co..... 38,787
Spectacle and eyeglass frames and mountings, certain named, Dupaul, Young Optical Co. 38,821, 38,822
Tablets for blood and nervous disorders, Pearson Drug Co. 38,804
Tonic, F. L. Beggs 38,806
Tonic, Independent Brewing Association.. 38,807
Tonic, blood, M. D. Perkins 38,805
Typewriter ribbons, Miller, Bryant, Pierce Co. 38,820
Vinegar, H. J. Heinz Co. 38,813
Whisky, J. G. Litz 38,811
Wines and brandies, Siegel-Cooper Co..... 38,812
Wood flooring and hard wood and basswood ceilings and shingles, hard, Wisconsin Land & Lumber Co..... 38,830

LABELS

"A Pocket Hat Luer," for hat luers, C. E. Sackett 9,393, 9,394

(Continued on page 144)

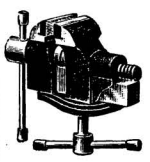
WOOD or METAL Workers



Without Steam Power should use our Foot and Hand Power Machinery. Send for Catalogues
A—Wood-working Machinery,
B—Lathes, etc.
SENECA FALLS MFG. CO.
695 Water St., Seneca Falls, N.Y.

ENGINE & FOOT LATHES MACHINE SHOP OUTFITS. TOOLS AND SUPPLIES CATALOGUE FREE 120 GULVART ST. SEBASTIAN LATHE CO. CINCINNATI, O.

Foot and Power and Turret Lathes, Planers, Shapers, and Drill Presses.
SHEPARD LATHE CO., 133 W. 2d St., Cincinnati, O.

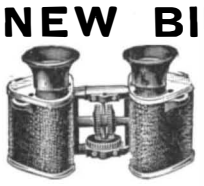


WALWORTH PIPE VISES
are the Heaviest and Strongest vises made.
RENEWABLE STEEL JAWS.
WALWORTH MFG. CO.,
128 TO 136 FEDERAL STREET, BOSTON, MASS.

There is never any question about the quality of a
B. F. BARNES UPRIGHT DRILL.
The tool here illustrated is our 20-inch Drill, and we guarantee it to drill up to 1 inch in steel and 1¼ inch in cast iron at a good gait and without strain. We build larger sizes and will be glad to send full data on our entire line to interested people.
B. F. BARNES CO., Rockford, Ill.

20th Century Tools.

NEW BINOCULAR.

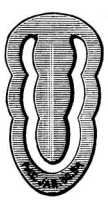


(The Trieder.)
Small as an opera glass. More powerful than the largest field glass. *Send for Circulars.*
QUEEN & CO.
Optical and Scientific Instrument Works,
1010 Chestnut Street,
NEW YORK: 59 Fifth Ave. PHILADELPHIA, PA.

SCRIBER. Points nicely tempered. Knurled sleeve nickeled.

Length, with short point, 9 in.; with long point, 12 in.
Price 45c.
Catalogue of Fine Tools free.
THE L. S. STARRETT CO. Box 13, Athol, MASS. U. S. A.

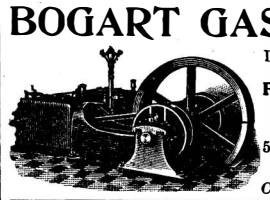
THE EUREKA CLIP
The most useful article ever invented for the purpose. Indispensable to Lawyers, Editors, Students, Bankers, Insurance Companies and business men generally. Book marker and paper clip. Does not mutilate the paper. Can be used repeatedly. In boxes of 100 for 25c. To be had of all booksellers, stationers and notion dealers, or by mail on receipt of price. Sample card, by mail, free. Manufactured by **Consolidated Safety Pin Co.,** Box 121, **Bloomfield, N. J.**



Size No. 2.

A. W. FABER
Manufactory Established 1761.
LEAD PENCILS, COLORED PENCILS, SLATE PENCILS, WRITING SLATES, INKS, STATIONERS' RUBBER GOODS, RULERS, ARTISTS' COLORS.
78 Reade Street, New York, N. Y.
GRAND PRIZE, Highest Award, PARIS, 1900.

BOGART GAS ENGINES



Double Cylinder, 50 h. p. and upward to 500.
FARRAR & TREFTS,
Steam Engine & Boiler Works....
54 to 56 Perry Street
BUFFALO, N. Y.
Catalogue on Application.

WELL DRILLING Machines
Over 70 sizes and styles, for drilling either deep or shallow wells in any kind of soil or rock. Mounted on wheels or on sills. With engines or horse powers. Strong, simple and durable. Any mechanic can operate them easily. Send for catalog.
WILLIAMS BROS., Ithaca, N. Y.

If You Want the Best Lathe and Drill
CHUCKS
BY
WESTCOTT'S
Strongest Grip, Greatest Capacity and Durability, Cheap and Accurate.

Westcott Chuck Co., Oneida, N. Y., U. S. A.
Ask for catalogue in English, French, Spanish or German.
FIRST PRIZE AT COLUMBIAN EXPOSITION, 1893.

Also for Bromide Enlarging, Copying, Photo-Engraving. Intensely brilliant, very portable, burns kerosene, costs 1 cent per hour. Send for lists including Stereopticons, Moving Pictures, Slides and Microscopes.
WILLIAMS, BROWN & EARLE,
Dept. 6, 918 Chestnut St., Philadelphia.

Beauty of Design

is one of the desirable features about our engine which has not been developed so much by other makers. We have the usual advantages of a good gas engine and also give you neatness and good looks, which makes an Ornament of your Power. Send for full particulars and new booklet giving sectional view.
HARDY MOTOR WORKS, Ltd.
Port Huron, Mich.

© 1902 SCIENTIFIC AMERICAN, INC.

"AMERICA'S SUMMER RESORTS"

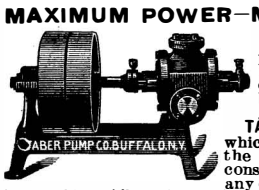
This is one of the most complete publications of its kind, and will assist those who are wondering where they will go to spend their vacation this summer.

It contains a valuable map, in addition to much interesting information regarding resorts on or reached by the

NEW YORK CENTRAL LINES

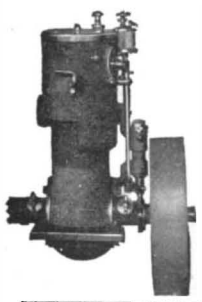
A copy will be sent free, postpaid, to any address on receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent, New York Central & Hudson River Railroad, Grand Central Station, New York.

MAXIMUM POWER—MINIMUM COST.



If you use a pump for beer, lard, acids, starch, petroleum, brewer's mash, tanner's liquor, cottonseed oil or fluids, hot or cold, thick or thin you want to get the TABER ROTARY PUMP which does the most work at the least expense. Simply constructed. Can be run at any desired speed. Perfectly durable. All parts are interchangeable. Needs no skilled workman. Derects guaranteed. *Catalogue free.*

TABER PUMP CO., 32 Wells St., Buffalo, N.Y., U. S. A.



TRUSCOTT MARINE MOTORS.

The simplest, most powerful, and highest speed gasoline engines of their class upon the market.

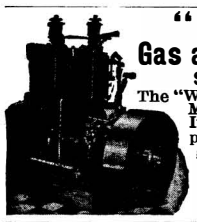
Made single, double, and triple cylinder, both two and four cycle, ranging from 1 to 40 H. P.

Catalog for the asking.

Truscott Boat Mfg. Co., ST. JOSEPH, MICH.

JUST $1 buys best bell outfit built. Easy to put up and an up-to-date convenience. We sell Bells, 32c.; dry batteries, 15c.; push buttons, 7c.; Insulated wire, 30c. lb.; lamps, 35c. Write for price list

LIBERTY ELECTRICAL SUPPLY CO. 136 Liberty St., New York



"WOLVERINE" Gas and Gasoline Engines

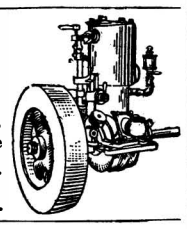
STATIONARY and MARINE.

The "Wolverine" is the only reversible Marine Gas Engine on the market. It is the lightest engine for its power. Requires no licensed engineer. *Absolutelysafe.* Mfd. by

WOLVERINE MOTOR WORKS, 12 Huron Street, Grand Rapids, Mich.

GASOLINE ENGINES

Marine & Stationary from 1-4 to 16 H. P.



A thoroughly satisfactory engine at a moderate price. Write for catalogue.

THE CLIFTON MOTOR WORKS, 233 E. Clifton Ave., Cincinnati, O.

IS YOUR BACK WORTH $1.50?

Our Trimmer gets along walks and curbing and around flower-beds and shrubs, where the lawn-mower won't cut.

Will you do it in the old back-breaking way with sheep-shears and scissors? No! Use the

"Canton" Lawn Trimmer

It cuts quickly and easily, and if your time is worth anything you can't afford to do without it.

Only Costs $1.50

It's the best yet; push it along, work the lever, and watch the grass fly.

THE CANTON CO., 1220 E. Fourth St., CANTON, - - OHIO.

50 YEARS' EXPERIENCE

PATENTS

TRADE MARKS DESIGNS COPYRIGHTS &C.

Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.

Patents taken through Munn & Co. receive *special notice*, without charge, in the

Scientific American.

A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.

MUNN & Co. 361 Broadway, New York

Branch Office, 625 F St., Washington, D. C.

"Anglo-Egyptian," for cigarettes, D. J. Vlasto 9,386
"Baby Ease," for medicine, T. P. Marshall 9,390
"Dr. Murri's Iron-Nerve Pills," for medicine, Altine Chemical Co. 9,389
"Eat-a-Biscuit," for cereal food, Grocers' Specialty Co. 9,387
"El Dimo," for cigars, A. Gutierrez Co.. 9,384
"Hatch's Biscuit," for biscuits, Bangor Biscuit Company 9,388
"La Cintillo," for cigars, A. C. Henschel & Co. 9,385
"Olympia Shoe Co.," for shoes, W. Edelstein 9,392
"Roycroft Liniment," for liniment, M. R. Stuart 9,391
"The Electric Dyspeptic Pad," for therapeutic apparatus, Electric Dyspeptic Pad Co. 9,395

PRINTS.

"A Cool Bearing," for frictionless bearing metal, Frictionless Metal Co..... 551
"Best on Earth," for frictionless metal, Frictionless Metal Co..... 552
"Wine that Maketh Glad the Heart of Man," for champagne, G. Rutledge.... 550

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.

NEW BOOKS ETC.

We have received from the University of Colorado the first number of a new publication entitled "University of Colorado Studies." This first number, at least, is equal to any of the scientific publications issued by the universities in the East. It has the additional merit of covering a very wide field. In this first number, for example, are articles on electricity, chemistry, mathematics, celestial mechanics, metaphysics and psychology—surely a range of subjects not often found in one publication. We wish the "Studies" all possible success.

CHEMICAL SOCIETIES OF THE NINETEENTH CENTURY. By Henry Carrington Bolton. Washington, D. C.: Published by the Smithsonian Institution. 1902. 8vo. Pp. 15.

Dr. Bolton has supplemented his Bibliography of Chemistry by a complete list of chemical societies of the nineteenth century, in which are listed practically all organizations of importance, devoted to chemical work.

THE CAR MOTOR. ITS NATURE, USE, AND MANAGEMENT. By Sir Henry Thompson, Bart. London and New York: Frederick Warne & Co. 1902. 110 pp., 3 illustrations. Price $1.

The distinguished author of this little volume has written it from practical experience with his own automobile, a 6½ horse power Daimler. The book forms an excellent elementary handbook of convenient pocket size, containing considerable desirable information from an owner who has had experience in driving a gasoline carriage. The rights of the automombilist on the road, and the methods pursued by the English constables in catching "scorchers" are thoroughly discussed, while an appendix of routes within 400 miles of London is by no means the least valuable feature. Considerable matter of legal interest will be found in this small volume, besides the concise instructions mentioned as to driving the different kinds of motor car.

A BIBLIOGRAPHY OF THE ANALYTICAL CHEMISTRY OF MANGANESE. 1785-1900. By Henry P. Talbot and John W. Brown. Washington: Published by the Smithsonian Institution. 1902. 8vo. Pp. vi.-124.

A fitting supplement to Dr. Bolton's Bibliography of Chemistry is this latest addition to the Smithsonian miscellaneous publications. Messrs. Talbot and Brown have reviewed Dr. Bolton's work and selected that portion of the bibliography bearing upon the qualitative detection and quantitative separation and determination of manganese for the use of analytical chemists. From the year 1830 on, however, the authors' work has been entirely independent.

PLATTNER'S MANUAL OF QUALITATIVE AND QUANTITATIVE ANALYSIS WITH THE BLOWPIPE. Translated by Henry B. Cornwall, E.M., Ph.D., assisted by John H. Caswell, A.M. Eighth edition, revised after the sixth German edition by Prof. Friedrich Kolbeck, New York: D. Van Nostrand Company. 1902. 8vo. Pp. xi-463. Price $4 net.

There probably has never been a better book prepared on the subject of blowpipe analysis than C. F. Plattner's admirable manual. The present edition, which is the eighth American edition, should be welcomed by students for the reason that it has been thoroughly revised after the latest German edition, thus bringing the book well up-to-date. The adoption of modern chemical notation and the omission of superfluous or antiquated tests considerably improve the work. Spectroscopic methods which properly do not belong in a book of this character are also omitted. Dr. Kolbeck, to whom the last German edition is due, was assistant to Dr. Richter, the unsurpassed master of blowpipe analysis and editor of the early Plattner editions.

PERFORATED METALS OF EVERY DESCRIPTION AND FOR ALL USES.

THE HARRINGTON & KING PERFORATING CO. 225 N. UNION ST. CHICAGO, ILL. U.S.A.

THE FRANKLIN DYNAMO

50 Watts, 10 Volts, 5 Amperes

3,000 to 4,000 revolutions. Sets of materials, finished parts, complete machines. For amateur construction—very efficient. Will drive a dental engine, sewing machine or small lathe; run as a generator, will furnish current for six 6-candle lamps. Parts, $3.50, $6.00, $8.50. Complete, $12.50. Write for circular 9.

Parsell & Weed. 129-131 W. 31st St., N.Y.

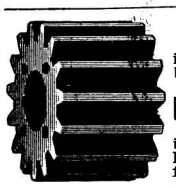
IROQUOIS MACHINE COMPANY

Manufacture under patents Improved Universal, Plain, Disc, Face

GRINDING MACHINES

WIRE DRAWING MACHINERY

150 Nassau Street, NEW YORK, U. S. A.



QUIET RUNNING

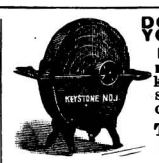
is only ONE of the advantages to be gained by using

New Process Pinions

instead of metal pinions. Our catalogue will tell you others. Write for it. We also make Metal Gears.

THE NEW PROCESS RAWHIDE CO., - Syracuse, N. Y.

DO YOU USE GRINDSTONES?



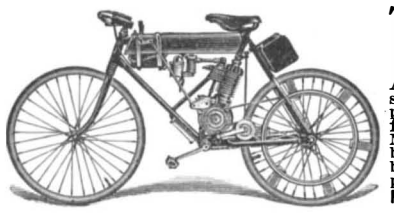
If so we can supply you. All sizes **mounted and unmounted**, always kept in stock. Remember, we make a specialty of selecting stones for all special purposes. ☞ *Ask for catalogue*

The CLEVELAND STONE CO. 2d Floor, Wilshire, Cleveland, O.

Millen's French Satin Jr.

The STANDARD blue print paper of the world—not the ordinary kind, but a *perfect* paper for photographic work, perfectly made and perfectly packed in sealed tubes. The delight of the professional and amateur PHOTOGRAPHERS. There is no better, it is the best. A postal card will bring full information of French Satin Jr. and our other photographic specialties.

THE J. C. MILLEN, M. D., PHOTOGRAPHIC CHEMICAL CO., Denver, Colo.

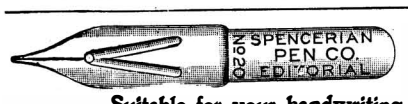


THE NEW MARSH MOTOR CYCLE

Model 1902. Price $175.

A Gasoline Motor made with crank-disk, shaft in one piece, extra strong bearings, exhaust valve mechanism entirely within base, perfect lubrication, secured against dust, carburetter of the float-feed type which has reached the greatest perfection. This Motor Cycle is the latest acquisition in the art. Made of the best material, simple and perfect in every detail. Constructed by high skilled experts in every department and is without a peer. Full descriptive circular on application.

MOTOR CYCLE MANUFACTURING CO., Brockton, Mass., U.S.A.



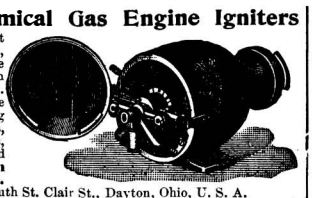
SELECT A PEN

Suitable for your handwriting from a sample card of 12 leading numbers for correspondence, sent postpaid on receipt of 6 cents in stamps.

SPENCERIAN PEN CO.

349 Broadway, New York.

Apple Economical Gas Engine Igniters



Are positively the best built for Stationary, Automobile and Marine Gas Engines, either touch or jump spark system. We are the leaders in the manufacture of Igniting Dynamos, Magnetos, Governors, Coils, Plugs, etc. Write for printed matter. **The Dayton Electrical Manfg. Company,** No. 80 South St. Clair St., Dayton, Ohio, U. S. A.

New York stock carried by Chas E. Miller, 97 Reade Street, N. Y.; Philadelphia Office, The Bourse; Chicago Office, 19-21 La Salle Street. St. Louis stock carried by A. L. Dyke, Linmar Building.

"BENEDICT-NICKEL" Seamless Tubing.

Dense; tough; highly non-corrosive; white metal clear through.

Benedict & Burnham Mfg. Co. Waterbury, Conn. New York, 253 Broadway. Boston, 172 High St.

A GOOD INVESTMENT

For $1.75 we will send by express (not prepaid), complete N. D. Outfit with full instructions for learning TELEGRAPH OPERATING. A fascinating study that will enable you to earn good wages. Send 25 cents for universal dating stamp, by mail, postpaid. Send for our catalog. *Established* 1879.

J. H. BUNNELL & Co., Inc., 20 Park Place, New York.

BURNISHINE

The most marvelous metal polish in the world.

Contains no Acids or anything injurious to the Metal or Hands.

Produces a wonderful brilliant lustre on Brass, Copper, Tin, Zinc, Silver, Nickel and all Metals.

A few rubs and the article is handsomely burnished.

Will not soil the hands or leave deposits in corners or surface of the metal.

Will restore burnt or rusty Nickel on Stoves to its original lustre.

Put up in cans at prices as follows: ½ Pint, 25c. 1 Pint, 40c. 1 Quart, 60c.

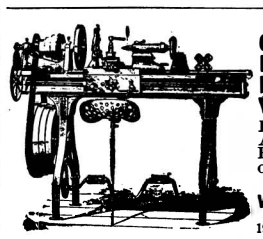
If your dealer does not keep it wrtie direct to J. C. PAUL & CO., 59 Dearborn St., Chicago.

Every Mechanic Should Own It.

Montgomery & Co.'s Tool Catalogue which is thoroughly up-to-date. 704 pages and discount sheet.

Sent by mail for 25 cents.

MONTGOMERY & CO., 105 Fulton St., New York City.

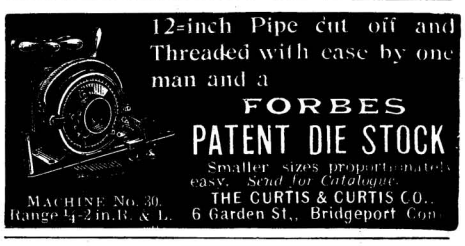


FOR GUNSMITHS, TOOL MAKERS, EXPERIMENTAL & REPAIR WORK, ETC.

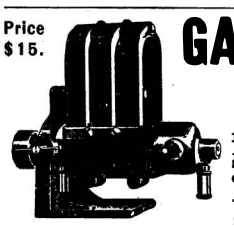
From 9-in. to 13-in. swing. Arranged for Steam or Foot Power, Velocipede or Stand-up Treadle. *Send for Catalogue.*

W. F. & JNO. BARNES CO. Established 1872. 1999 Ruby St., ROCKFORD, ILL.

FLY PAPERS.—FORMULAS FOR Sticky Fly Papers are contained in SCIENTIFIC AMERICAN SUPPLEMENT Nos. 1057 and 1324. Each issue contains several recipes. Price 10 cents each, from this office, and from all newsdealers.


12-inch Pipe cut off and Threaded with ease by one man and a
FORBES
PATENT DIE STOCK
Smaller sizes proportionately easy. Send for Catalogue.
MACHINE No. 30. Range ¼-2 in. R. & L.
THE CURTIS & CURTIS CO., 6 Garden St., Bridgeport Conn

Price $15.



GAS ENGINE IGNITERS

for Marine, Stationary and Automobile engines. Will save their cost many times over in one year.

Write for circulars.

The Carlisle & Finch Co., 233 E. Clifton Ave., Cincinnati, O

The Best Thing on Wheels

ALL ROADS ARE ALIKE TO

The OLDSMOBILE

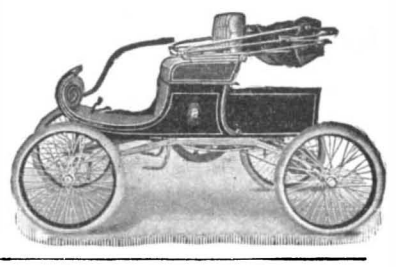
RUNS EVERYWHERE

Nothing to Watch but the Road Ahead.

Our new red catalog illustrates and describes it in detail.

THE PRICE IS RIGHT

OLDS MOTOR WORKS, DETROIT, MICH.



? ? ?

What Do You Want To Buy?

We can tell you where to buy anything you want.

Write us for the addresses of manufacturers in ANY line of business.

Novelties, Special Tools, Machinery, Equipments, New Patent LABOR SAVING DEVICES.

MUNN & CO., Publishers of the SCIENTIFIC AMERICAN, 361 BROADWAY, NEW YORK.

© 1902 SCIENTIFIC AMERICAN, INC.

EARN MORE Study in spare time. We teach you what you need to know to earn more in your own business or another. **Engineering, Drafting, Art, Architecture, Mining, Metallurgy, Business, Stenography, Journalism, Bookkeeping, etc.**

Write for free catalogue 6, with full particulars.

☞ *Special Discounts Now.*

THE CONSOLIDATED SCHOOLS, 156 Fifth Ave., N. Y.

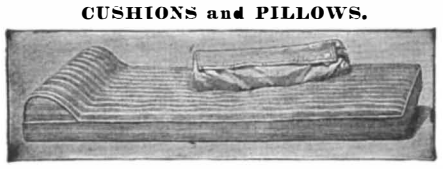
RHODE ISLAND COLLEGE OF AGRICULTURE and MECHANIC ARTS
KINGSTON, R. I.

A technical-scientific college for young men and young women. Courses in Agriculture, Mechanical and Electrical Engineering, Chemistry, Biology and General Science lead to the degree of B. S. Preparatory Department. Dormitories. Tuition free. Send for illustrated catalogue.

J. H. WASHBURN, Ph.D., President.

TELESCOPES SEND FOR CATALOGUE W. & D. MOGEY. BAYONNE CITY, N.J.

RESTFUL SLEEP
In Camp, on the Yacht and at Home.
"Perfection" Air Mattresses,
CUSHIONS and PILLOWS.



Style 61. Camp Mattress with Pillow attached. Also showing Mattress deflated.

Clean and Odorless, will not absorb moisture.
Can be packed in small space when not in use.

☞ *Send for Illustrated Catalogue.*

MECHANICAL FABRIC CO., PROVIDENCE, R. I.

GROUND FLOOR
THE RAND GOLD MINING CO.
—OF—
THUNDER MOUNTAIN

Owns six full claims 600x1,500 feet each (over 120 acres) on

RAINBOW MOUNTAIN

The ore is free milling. Its value is from $8 to over $100 a ton. It lies in quarries like the Homestake mine of Deadwood, S. D., which has paid in

DIVIDENDS from JANUARY, 1902, to JULY, 1902, $630,000 on $4 ORE.

A 40-stamp mill will crush enough of our ore in a day to yield a

DAILY INCOME OF $2,400.00,

Equal to 36 per cent. per annum upon par value of the total capitalization.
FOR DEVELOPMENT PURPOSES,
FOR INSTALLING MACHINERY,
We offer a limited amount of stock at the low price of

TEN CENTS PER SHARE (Par Value $1.00.)

To secure shares at this price, subscriptions should be forwarded immediately, as the next allotment will be much higher in price. Stock will advance

RAPIDLY TO PAR.

We will send you

LATEST MAP OF THUNDER MOUNTAIN, JUST OUT.

For prospectus and information about the installment plan apply to the Company's Fiscal Agents,

THE MUTUAL SECURITY & TRUST COMPANY,
Mining Department, Room 1119,
279 Dearborn Street, - - - - - - - - Chicago, Ill.

MENNEN'S BORATED TALCUM TOILET POWDER

A Positive Relief For PRICKLY HEAT, CHAFING, and SUNBURN, and all afflictions of the skin.
"A LITTLE HIGHER IN PRICE, PERHAPS, THAN WORTHLESS SUBSTITUTES, BUT A REASON FOR IT."
Removes all odor of perspiration. Delightful after Shaving. Sold everywhere, or mailed on receipt of 25c. Get Mennen's (the original). *Sample Free.*
GERHARD MENNEN COMPANY, Newark, N.J.

JUST PUBLISHED

Practical Pointers For Patentees

Containing Valuable Information and Advice on

THE SALE OF PATENTS.

An Elucidation of the Best Methods Employed by the Most Successful Inventors in Handling Their Inventions.

By F. A. CRESEE, M. E.
152 Pages. Cloth. Price, $1.00.

THIS is the most practical, up-to-date book published in the interest of Patentees, setting forth the best methods employed by the most successful Inventors in handling their patents. It is written expressly for Patentees by a practical Inventor, and is based upon the experience of some of the most successful Inventors of the day.

It gives exactly that information and advice about handling patents that should be possessed by every Inventor who would achieve success by his ingenuity, and will save the cost of many expensive experiments as well as much valuable time in realizing from your inventions. It contains no advertisements of any description and is published in the interests of the Patentee alone, and its only object is to give him such practical information and advice as will enable him to intelligently handle his patent successfully, economically and profitably.

It gives a vast amount of valuable information along this line that can only be acquired by long, expensive experience in realizing from the monopoly afforded by a patent.

☞ *Send for Descriptive Circular.*

MUNN & CO.,
Publishers, 361 Broadway, New York.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled

(8668) A. M. asks: 1. I have made motor described in SUPPLEMENT No. 641 and it runs perfectly as a motor, but will not generate any current when driven as a dynamo. It is series wound. Please let me know the remedy. A. Small motors very often are not wound so that they will excite their own fields and they cannot be used as dynamos, except by disconnecting the field and using a battery to excite the field. 2. Would there be any practical way to run it on 110-volt alternating lighting circuit? A. No.

(8669) H. M. W. writes: We understand there is an easily prepared paper which may be used for the finding of the negative and positive poles of an electric wire. Will you kindly inform us how to make this paper and whether it will keep? We only wish for a small quantity. A. We give below two methods for this purpose, both of which are easy. First method: Dissolve sodium sulphate, a teaspoonful, in a half pint of water, in which also dissolve about the same quantity of potassium iodide and of starch. To dissolve the starch the water must be heated. Soak white blotting paper in this solution and dry it. Cut it into strips of any convenient size, a half inch by two inches is suitable. Keep the paper in a dry place such as a tin box or a glass bottle. To use, moisten a strip and place the two poles upon it, nearer together or farther apart, according to the voltage of the current. A dark spot will appear at the *positive* pole. Second method: Dissolve 15 grains of phenol-phtalein in a half ounce of common alcohol. Dissolve also 20 grains of sodium sulphate in 4 ounces of water. Soak blotting paper in the first solution and drain off the superfluous liquid. Then soak it in the second solution and dry it. Afterward treat it in the same manner as in the first method. A red spot appears at the *negative* pole.

(8670) A. S. writes: Our M. E. Church steeple of Freeport is about 160 feet high, is slate roofed or covered and the top consists of a sheet iron ornament some 12 or 15 feet: the church is of brick. The steeple has been struck and badly damaged by lightning within 3 years, although it stood for 20 odd years before it was first struck. It is thought by some that the large number of overhead telephone wires that go right by the church and the telephone station just across the street tend to attract lightning, which strikes the steeple first, it being a considerably higher point. Some contend that proper lightning rods would prevent damage, while others claim that lightning rods are incapable of carrying the great amount of electricity forming such a bolt of lightning. A. 1. We should not dare to have a building with an iron top disconnected with the earth metallically, as is this church spire. It is an invitation to a visit of the lightning. The lofty Washington Monument, in Washington, was struck and damaged till its metal tip was grounded by a lightning rod, since which it has been repeatedly struck, but without damage. Suitable lightning rods certainly are of service in protecting a building. We should suppose that the telephone wires were a partial protection to a neighborhood. 2. Is it a fact that no suction pump will pump or draw a greater height than 33½ feet before entering the pump, or, in other words, before passing through the valves? If water can be raised a greater height by such a pump before it passes through the pump valves can you tell what distance it can be drawn and what causes the limit if there is any? A. A lifting, or as it is sometimes called, a suction pump, can raise water no more than 28 to 30 feet. Theoretically 34 feet is the limit to which the pressure of the atmosphere can push water up a tube with a vacuum above the water. No pump can exhaust the air above the water perfectly, hence no pump can get water 34 feet above the level of the water below. The pump lifts the air off the water in the pipe; the air outside the pipe pushes on the water in the well and pushes it up into the partial vacuum in the pipe below the valve of the pump. For this see any text book of physics under pumps in pneumatics.

(8671) A. J. T.: Use zapon celluloid lacquer for chandelier work. It can be reduced by using the proper solvent.

September 30

Young men, are you satisfied with your present position and income, or would you like to **know more**, be **more important in the world's work** and **make more money?** This is an age of **specialists.** Take up some special study and **master** it; then the world will pay well for your services.

Perhaps you are tied down by circumstances, and cannot spare the time or money necessary to go to a technical training-school—**then let the school come to you.** The study room is your own home. The study hours are whatever time you can give to it. Your lesson papers are examined and corrected by **college professors,** and everything is made clear, interesting and easy. If you **act quickly** you can take advantage of our correspondence course and secure a technical education for almost nothing. By vote of the Trustees of the American School of Correspondence we have for some time been issuing to deserving young men a limited number of

FREE SCHOLARSHIPS.

These scholarships provide a full technical education in **Electrical, Mechanical, Locomotive, Marine and Stationary Engineering, Heating, Plumbing and Ventilation**—*without charge for tuition.* Of course no institution could be expected to continue such an offer indefinitely; we therefore announce that this offer will be

Withdrawn September 30th.

Applications for scholarships postmarked later than September 30th can be accepted only at regular fees ($50.00). Students awarded scholarships will be expected to bear the expense of postage and text-books. Full instruction given in **Mechanical Drawing** with each course.

Examination credits count toward Degree in resident technical school.

For Information and Handbook giving Courses, Methods, Terms, etc., address the Registrar.

AMERICAN SCHOOL OF CORRESPONDENCE, BOSTON, MASS.

DRINK PURE WATER. You can't possibly get seeds or foreign particles into the mouth when you use a **"Snedeker"** adjustable guard and filter on your cup or glass. Is fine for iced drinks and for Hotel use. Made of Wessell silver. Sample by mail **25c., 5** for **$1.00.** Special Agent's Outfit **$2.00.**
SNEDEKER & POLHEMUS. - - - - NYACK, N. Y.

"THIS BEATS NEW JERSEY." Charters procured under South Dakota laws for a few dollars. Write for Corporation laws, blanks, by-laws and forms to PHILIP LAWRENCE, late Ass't Secretary of State, Huron, Beadle Co., South Dakota.

MATCH Factory Machinery. W. E. WILLIAMS, Mfr., 217 South Clinton St., Chicago, U. S. A.

PUZZLE BOOKS "Mental Nuts."—Can you crack 'em?
"Knots."—100 catch problems.
"1400 Conundrums and Riddles."
"Great American Puzzle Book."
Price 10c. each, 4 for 30c., postpaid.
Home Supply Co., Dept. 56, 132 Nassau St., New York.

WANTED REPRESENTATIVE

Business men wanted for cities of 10,000 and over to open exhibition parlors or stores for the display and sale of our

"KEYLESS CLOCK,"

Just being introduced to the public. Clocks are self-winding and run a year without attention: no one will buy key wound clocks when they see and have an opportunity to buy the latest thing; full line of samples now ready; parties having $500 and upward to invest and ability to manage can secure agency for cities not already taken; parties making arrangements now will have name appear in our advertisements. Address The United States Clock Co., executive offices, No. 405 Broome Street, New York.

I Print My Own Cards

Circulars, newspaper. Press, **$5.00.** Larger size, **$18.00.** Money saver. Big profits printing for others. Type setting easy, rules sent. Write for catalog, presses, type, paper, etc., to factory, **The Press Co., Meriden, Conn.**

SHOE BLACKING.—FORMULAS FOR liquid and solid blacking are given in SUPPLEMENT Nos. **1213** and **1239.** Price 10 cents each. For sale by Munn & Co. and all newsdealers

ICE MACHINES, Corliss Engines, Brewers' and Bottlers' Machinery. THE VILTER MFG. CO., 899 Clinton Street, Milwaukee Wis.

Experimental & Model Work
Cir. & advice free. Wm. Gardam & Son, 45-51 Rose St., N.Y.

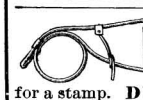
NOVELTIES & PATENTED ARTICLES
Manufactured by Contract. Punching Dies, Special Machinery. E. Konigslow & Bro., 181 Seneca St. Cleveland, O.

NEW YORK SHOPPING by a responsible and experienced lady. Send for circular.
MRS. LORD, 41 West 24th Street, New York City.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches & Elevators
PROVIDENCE, R. I.

MODELS CHICAGO MODEL WORKS ESTABLISHED 1867 179 E. MADISON ST. CHICAGO, ILL. WRITE FOR CATALOGUE OF MODEL SUPPLIES.

DRYING MACHINES. S. E. WORRELL, Hannibal, Mo.



PATENT FOR SALE. **No. 105,463.** A New Device for holding soap, towels, napkins, &c. Full information for a stamp. **DUSEK BROS., Crow Lake, S. D.**

MODELS & EXPERIMENTAL WORK. Inventions developed. Special Machinery.
E. V. BAILLARD, Fox Bldg., Franklin Square, New York.

AVICOLA URUGUAYA. Prest. JOHN A. SMITH, Montevideo, S. America, needs catalogues of fowls, pine buildings, incubators and all sorts of utensils for a complete hatching establishment; catalogues of denaturalized alcohol motor automobiles, special automobiles for carrying eggs and fowls to town. Plans for a dairy establishment for butter and cheese making, to milk daily from 1,500 to 2,000 cows. Catalogues of appropriate motors, freezing apparatus, machines and utensils therewith, with prices.

STEEL TYPEWRITER TYPE TYPE WHEELS. MODELS & EXPERIMENTAL WORK. SMALL MACHINERY NOVELTIES & ETC. NEW YORK STENCIL WORKS 100 NASSAU ST. N.Y.

D. L. HOLDEN REAL ESTATE TRUST B'LD'G PHILA., PA
SOLE MANUFACTURER
REGEALED ICE MACHINES
SEE FIRST PAGE SCIENTIFIC AMERICAN SEPT. 2. 1899.

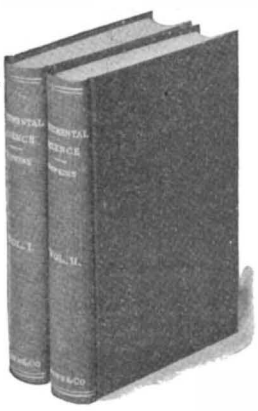
READY THIS WEEK.

Twenty-Third Edition

Experimental Science

BY George M. Hopkins

Revised and Greatly Enlarged.
2 Octavo Volumes.
1,100 Pages. 900 Illustrations.
Cloth Bound, Postpaid, $5.00.
Half Morocco, Postpaid, 7.00.
Or Volumes Sold Separately:
Cloth, $3.00 per Volume.
Half Morocco, $4.00 per Volume.



EXPERIMENTAL SCIENCE is so well known to many of our readers that it is hardly necessary now to give a description of this work. Mr. Hopkins decided some months ago that it would be necessary to prepare a new edition of this work in order that the many wonderful discoveries of modern times might be fully described in its pages. Since the last edition was published, wonderful developments in wireless telegraphy, for example, have been made. It was necessary, therefore, that a good deal of new matter should be added to the work in order to make it thoroughly up-to-date, and with this object in view some 200 pages have been added. On account of the increased size of the work it has been necessary to divide it into two volumes, handsomely bound in buckram. It may be interesting to note the following additions that have been made to these volumes:

Volume I contains in addition to a large number of simple, well illustrated experiments, a full description of a ¼ H. P. electric motor made expressly for illustration in this edition of "EXPERIMENTAL SCIENCE." It is an ENCLOSED SELF-REGULATING electric motor for a 110 volt circuit. It can be operated by a current from a 110 volt lamp-socket, yielding a full ¼ H. P., or it may be used as a dynamo, furnishing a current capable of operating three 16-candle power, 110 volt incandescent lamps. The construction of the machine is perfect enough to admit of enlarging or reducing its size if desired.

Volume II contains much on the general subject of electricity, besides new articles of great importance. Among these the subject of alternate current machinery is treated. Wireless Telegraphy and Telephony receive attention. Electrical Measuring Instruments, The Electric Clock, The Telegraphone, Experiments in High Voltage, The Nernst Lamp, and Measuring the Heat of the Stars are all thoroughly illustrated and described.

The unprecedented sale of this work shows conclusively that it is the book of the age for teachers, students, experimenters and all others who desire a general knowledge of Physics or Natural Philosophy.

SEND FOR DESCRIPTIVE CIRCULAR.

MUNN & CO., Publishers, 361 Broadway, New York.

© 1902 SCIENTIFIC AMERICAN, INC.

THOROUGH INSPECTIONS

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

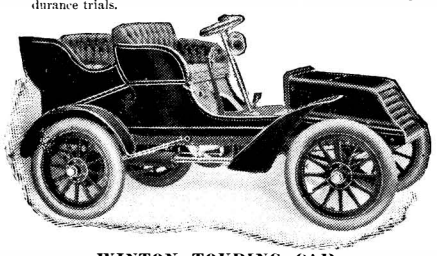
AND INSURANCE AGAINST LOSS OR DAMAGE TO PROPERTY AND LOSS OF LIFE AND INJURY TO PERSONS CAUSED BY

STEAM BOILER EXPLOSIONS

J. M. ALLEN, President — W. B. FRANKLIN, Vice President
J. B. PIERCE, Secretary — F. B. ALLEN, 2d Vice President
L. R. BRAINERD, Treas. — L. F. MIDDLEBROOK, Asst Sec'y

WINTON

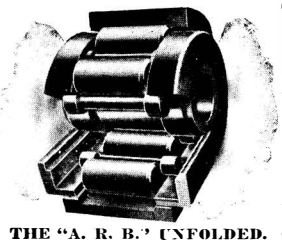
GOLD MEDAL (first award) in the official speed trials.
SILVER CUP (first award) in the official hill climbing trials.
BLUE RIBBON (first award) in the official 100-mile non-stop endurance trials.



WINTON TOURING CAR.

It contains the simplest, most practical and best constructed motor manufactured or sold in America. Our new catalog sent upon request.

The Winton Motor Carriage Co., Cleveland, O., U.S.A.
New York. Chicago. Boston. Philadelphia.



THE "A. R. B." UNFOLDED.

This is a ROLLER BEARING
Not a GRINDING Machine
Every PART Rolls.

Plain bearings and caged roller bearings rub and grind. Send for circular.

American Roller Bearing Co., 32 Binford St., Boston, Mass.
K. Franklin Peterson, 165 Lake St., Chicago, Ill. Gen. Mgr. Western Dept.

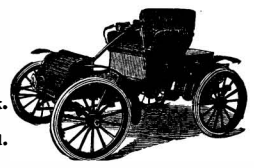
DIXON'S GRAPHITOLEO

An all around lubricant for Cylinders, Engine Slides, Chains, Gears, Etc. of Automobiles. It is made of pure vaseline and Dixon's No. 635 Graphite. It is equally useful for general use.

Small Sample Free.

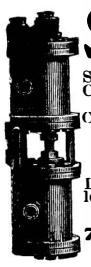
JOSEPH DIXON CRUCIBLE CO.
Jersey City, N. J.

$750
HYDRO-CARBON.
20-Mile Speed.
20 per cent. Grades.
100-Mile Gasoline Tank.
300-Mile Water Tank.
900 lbs. 6 H. P. Actual.
Write for Catalogue.



FRIEDMAN AUTOMOBILE CO.,
3 E. Van Buren Street. Chicago, Ill.

THE VICTOR Steam Pumps



Size, 9 inches by 3 inches, weight, 4½ pounds.
Capacity of Air Pump, 80 pounds pressure on tanks or tires.
Capacity of Water Pump, 3 gallons per minute against 200 pounds boiler pressure.

PRICE, $30.00 EACH.

These pumps have been adopted by the Locomobile Co., the Mobile Co., and other leading manufacturers of steam carriages.

OVERMAN AUTOMOBILE CO.,
7 East 42d Street, New York.
Send for Illustrated Circular.

NEW ENGLAND WATCHES

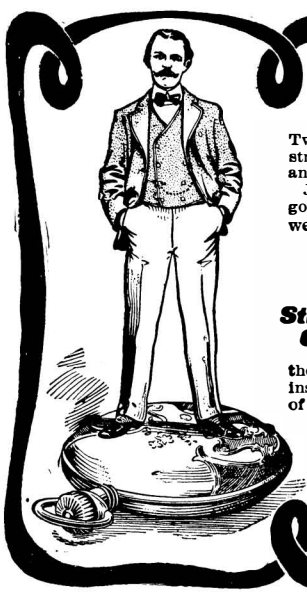
have a world-wide reputation gained by results as accurate timekeepers. We make all sizes and styles. We sell only complete watches. Catalogs sent on request.

THE NEW ENGLAND WATCH CO.

37 & 39 Maiden Lane, New York — 131 Wabash Ave., Chicago.
Claus Spreckels Building, San Francisco.

Orient Motor Cycle.

PRICE $250.00
Fitted with the New Orient 3 H. P. Motor.
Speed over 40 Miles per hour.
The Most Powerful Motor Bicycle in the World.
Write for Particulars. *Agents Wanted.*
WALTHAM MFG. CO., Waltham, Mass.



STRENGTH

Twenty-five years ago in acquainting jewelers with the strength of the Jas. Boss Stiffened Gold Watch Cases, an enterprising salesman used the method here shown.

Jas. Boss Cases are still the strongest cases made. As good as solid gold in appearance. Better than gold in wearing quality. Less than solid gold in cost. In a

JAS. BOSS Stiffened GOLD Watch Case

there is a layer of very hard composition between an inside and outside layer of solid gold reducing the cost of the case, and adding greatly to its strength.

BOSS Cases are guaranteed to wear for 25 years; are recognized as the standard, and sold as such by all jewelers. Write us for a booklet.

The Keystone Watch Case Company, Philadelphia.

By This Mark You Know Them

SAVAGE

Only Hammerless Repeating Rifle in the World.

HIGHEST Development of SPORTING RIFLES

Constructed to shoot Six Different Cartridges.
Adapted for GRIZZLY BEARS & RABBITS.
.303 and 30-30 Caliber.

Every Rifle thoroughly guaranteed.
Write for new illustrated catalogue A.

SAVAGE ARMS CO., Utica, N. Y., U. S. A.
Manufacturers of SAVAGE Magazine and Magnetic Hammers. Send for Circular.

PARALLEL CH BESLY & Co CLAMPS ALL ANGLES SIDES Chicago Ill U.S.A.

Scales All varieties at lowest prices. Best Railroad Track and Wagon or Stock Scales made. Also 1000 useful articles, including Safes, Sewing Machines, Bicycles, Tools, etc. Save Money. Lists Free. Chicago Scale Co., Chicago, Ill.

The GROUT STEAM CARRIAGE

Fulfills the expectation of the purchaser who desires the

BEST

GROUT BROS.,
ORANGE, MASS.

THE MOST MODERN AUTO
ELMORE AUTOMOBILES.

Practical, Durable Efficient. Easy to control at any speed. Double cylinder motor, smooth gliding motion. 2 models, $800-$1500. Get further information free.

ELMORE MANUFACTURING CO., Clyde, O., U. S. A.

CRUDE ASBESTOS
DIRECT FROM MINES

PREPARED ASBESTOS FIBRE for Manufacturers use

R. H. MARTIN,
OFFICE, ST. PAUL BUILDING
220 B'way, New York.

JESSOP'S STEEL THE VERY BEST FOR TOOLS, SAWS ETC.
Wm JESSOP & SONS Lº 91 JOHN ST. NEW YORK

CHARTER ENGINE

USED ANY PLACE BY ANY ONE FOR ANY PURPOSE
Stationaries, Portables, Sawing Outfits, Hoisters, Engines and Pumps.
FUEL.—Gasoline, Gas, Distillate.
Send for Illustrated Catalogue and Testimonials, and State Your Power Needs.
CHARTER GAS ENGINE CO., Box 148, STERLING, ILL.

FIFTEEN MILLION BARRELS OF CEMENT A YEAR NOW

Ground in the Griffin Mill

AN UNPARALLELED RECORD OF AN UNPARALLELED MILL

NOTE.—In addition to the large number of Griffin Mills in use wherever Portland Cement is made, the following concerns are now installing additional ones:

Associated Cement Manufacturers of England,	Texas Portland Cement Co., ... Dallas, Texas.
Lehigh Portland Cement Co., ... Ormrod, Pa.	Cayuga Lake Cement Co., ... Ithaca, N. Y.
" " " " . . . . Mitchell, Ind.	National Portland Cement Co., ... Durham, Ont.
" " " " . . . . . Wellston, O.	Sandusky Portland Cement Co., ... Syracuse, Ind.
Central Cement Co., ... Coplay, Pa.	Newaygo Portland Cement Co., . . . Newaygo, Mich.
Glens Falls Portland Cement Co., Glens Falls, N. Y.	Great Northern Portland Cement Co., Baldwin, Mich.
Alpha Portland Cement Co., ... Alpha, N. J.	Midland Portland Cement Co., ... Bedford, Ind.
Iola Portland Cement Co., ... Iola, Kansas.	Bonneville Portland Cement Co., . . . Siegfried, Pa.

If the Griffin Mill wasn't the greatest cement grinder the world has ever known, these large works, would not now be placing additional mills. Full particulars cheerfully furnished.

BRADLEY PULVERIZER CO., BOSTON

American Success Series

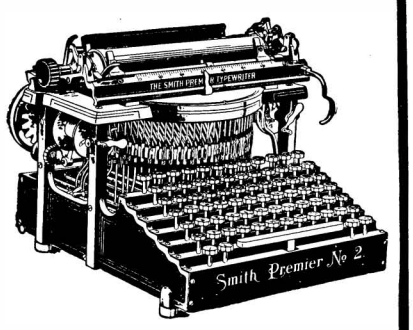
Hon. J. H. BROMWELL

Congressman from Ohio, on Committee of Post Offices and Post Roads, formerly wrote and taught stenography.

"Improvement the order of the age"

A rigid test of every part is the best guarantee of the whole great

Success,
The Smith Premier Typewriter



American Success Series in Book Form.—At the end of this year, the Smith Premier Typewriter Company will publish a handsome booklet containing pictures and brief biographies of twelve successful Americans who have profited by their use of stenography or typewriting. These books will be mailed free only to persons who send us their names and addresses, with request for same.

The Smith Premier Typewriter Co., Syracuse N. Y., U. S. A.

Free Tuition *in the* Kodak Correspondence School of Photography

to every owner of a Kodak or Brownie Camera who purchases a one dollar copy of "Picture Taking and Picture Making."

EASTMAN KODAK CO.

Circular by mail upon request. Rochester, N. Y

BRISTOL'S RECORDING INSTRUMENTS.

Pressure Gauges, Vacuum Gauges, Voltmeters, Amperemeters, Wattmeters, and Thermometers, make continuous records *Day and Night.* Will pay for themselves. Every instrument fully guaranteed and sent on 30 days' trial. ☞ *Send for Circulars and Specimen Chart.*

The Bristol Company Waterbury Conn
SILVER MEDAL PARIS EXPOSITION.

STEWARD'S WONDER

The Exponent of Highest Art in
ACETYLENE BURNERS Sample 25c. in stamps Ask for catalogue C.
STATE LINE MFG. CO., Chattanooga, Tenn., U. S. A.
107 Chambers St., New York.

Ride a STEFFEY MOTOR CYCLE

You can convert your bicycle into a practical Motor Cycle for a small cost. We have motors from 1¼ to 3 H. P. for Auto, Stationary or Marine, or will furnish the castings from which to build them. A two-cent stamp gets our catalogue.

STEFFEY MFG. CO.
2720 Brown Street, Philadelphia, Pa.

© 1902 SCIENTIFIC AMERICAN, INC.